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Machine and Hand Labor.

How the civilized world has multiplied its industrial productiveness by increased use of machinery and mechanical power is illustrated by the following comparisons drawn for "Gunton's Magazine" by Carroll D. Wright, with the aid of a recent report of an investigating commission appointed by Congress:

"A thousand paper bags could formerly be made in 6 hours and 30 minutes by hand; they are now made in 40 minutes with the aid of a machine. To rule 100 reams of paper on both sides by hand required 4,800 hours; with a ruling machine the work is done in 2 hours and 30 minutes of one man's time. In shelling corn by hand 66 hours and 40 minutes would be required to shell a quantity which can be handled by a machine in 36 minutes. A mowing machine cuts seven times as much grass per hour as one man can cut with a scythe. These examples might be extended indefinitely, but a more forceful illustration is found by considering the total horse-power applied to machines in this country and calculating how many men it would require to do the same work. For such calculations the census figures of 1890 must be used.

"One horse-power is equivalent to the power of six men. Thus, if the work of 63,481 men in the flour mills of the United States is supplemented with the use of 752,365 horse-power, the power is equivalent to the work of 4,514,190 additional men. In other words, the power does seventy-one times as much work as the employees. The ratio differs radically in different industries. Mr. Wright finds that the total horse-power used in the United States in 1890 was about 6,000,000, equivalent to the work of 36,000,000 men, while only 4,476,884 persons were employed, the two kinds of power having a ratio of 8 to 1. A force of 36,000,000 men represents a population of 180,000,000, so that, if the products of the manufacturing establishments were all made by hand, it would require a population of that size to do it, with none left for agriculture, trade, transportation, mining, forestry, the professions or any other occupations.

"A still more striking illustration is found in our transportation system. In 1890 there were over 30,000 locomotives in this country. It would take 57,940,320 horses to do their work, or 347,425,920 men. In countries like China nearly all the work of transportation is actually done by man-power, and no further explanation of the difference between America and Asia is required. By the use of steam we are evoking aid from the stored-up heat in our coal beds equivalent to the population of the whole earth, while the Chinaman lets his coal lie underground, packs his loads on his back and does his manufacturing largely by hand.

"Mr. Mulhall, the British statistician, calculated in 1895 that the use of steam power had increased fivefold in the United States in thirty-five years, thus more than trebling the collective working power of the population. He also remarks that the working energy of one American is more than double that of one European. Thus the civilized world, with the United States leading, is yearly doing a greater amount of useful work, while Asia does no more than it did a thousand years ago. This fact alone will explain the demand for the 'open door' and the increasing world domination of the machine-using nations."

Spiral Gears.

Judging by the amount of correspondence which is coming to this office on the subject, spiral gears are at present attracting a good deal of attention and consuming a proportionate amount of gray matter among machine designers and constructors. The increased use to which these gears are being put is no doubt due to the growing knowledge of the fact that they are not necessarily the inefficient and short-lived device that they were considered to be, but that, when properly laid out, they are an extremely satisfactory machine detail. The laying out of such a pair of gears is much more of a problem than would be supposed at first sight, and this, combined with our partiality for graphical solutions of mechanical problems, gives us a good deal of satisfaction in presenting, in another column, the very plain and simple treatment of the subject by Mr. Bruce. We are also led to express the opinion that, if laid out on a reasonably large scale and with sufficient care, his construction will be found to answer all present requirements. It must be remembered that the graduated circles of milling machines are usually divided to degrees only, and that any finer division than that can be obtained only by estimation. Under these circumstances, it is clearly absurd to contend that graphical methods of laying out the work are insufficient in accuracy. To contend against the graphical methods and then accept the present division of the graduated circles, is clearly a case of "straining at a gnat and swallowing a camel."

We would not be understood, however, as approving the present division of the circles as sufficient. On the contrary, we believe that for many purposes finer divisions are needed, and indeed that, considering its small cost, the addition of a vernier to read to, say, 10 min. of arc would be well repaid. When these additions are made to milling machines, we shall be the first to advocate their use in obtaining as high a degree of accuracy as possible in spiral gears, and it may then appear that calculation is necessary to obtain that end. In the meantime, however, we have no doubt of the sufficiency of Mr. Bruce's graphical method of laying out to equal and surpass the accuracy possible with present facilities for construction.

The American Machinist at the Paris Exposition.

Mr. F. J. Miller, editor-in-chief of this paper, sailed for Europe April 4 on the "St Paul," of the American line. The chief object of the trip is to note and describe the interesting things of a mechanical nature which are to be seen at the Exposition, and our readers may expect to be fully informed of such things through our columns.

Machinery Exhibition at Christiania.

Consul Bordewich sends from Christiania, February 16, 1900, a programme of the permanent machinery exhibition which has been opened in that city. Manufacturers, agents, and other interested parties are invited to exhibit. The metal, woodworking, spinning and weaving industries will be represented, as well as works in paper, leather, rubber clothing, etc.; also engines. The programme sets forth that machinery, tools, etc., can be exhibited at a low rent in centrally situated rooms. Appliances can be shown in operation without extra expense for driving power. New and patented machinery and appliances may be exhibited and advertised cheaply and effectively. Catalogs of the exhibition will be distributed without extra expense to the exhibitors.

Mr. Bordewich advises that new inventions should be patented in that country before they are shown. Application for patent in Norway should be made within six months after patent is granted in the United States. Import dues are light. Goods should be sent knocked down, if possible, to save freight. For information address the Alfheim Company, St. Olafsgade, 22, Christiania.

Convention of the National Association of Manufacturers.

The Fifth Annual Convention of the National Association of Manufacturers is to be held in Boston, April 24, 25 and 26. The business sessions will be held in Tremont Temple. On Tuesday evening, April 24, there will be an informal social gathering and entertainment; on Wednesday evening there will be a public meeting for the discussion of some subject of interest to manufacturers, and on Thursday evening there will be a banquet in the Mechanics' Building. It is expected that President McKinley will be the guest of honor on this occasion. Applications for tickets should be made to C. J. H. Woodbury, secretary, Room 57, No. 45 Milk street, Boston. Arrangements have been made for reduced railroad fares and special hotel accommodations.

Technical Publications.

"The Fluid Screw," by Paul Pacher, is a pamphlet of sixty-six pages, in German, published by A. Amonesta, Margarethenstrasze, 7, Vienna, Austria. It is a treatise upon the propellers of vessels and airships, the sails of windmills, etc. Price, 1½ marks (37 cents).

"A Simple and Practical Method for Analyzing the Movement of the Slide Valve with the Aid of the Model Diagram Chart." By M. R. Conway. 27 4x6-inch pages. The Lunkenheimer Company, Cincinnati and New York.

This is an exceedingly plain and direct method of showing the action of the plain slide valve. The model is a working model of cardboard, and shows the action of the eccentric and valve with great clearness. The pamphlet is for free distribution to engineers.

"Electric Wiring." By Cecil P. Poole. 101 4½x6½-inch pages, with 43 wiring diagrams. The Power Publishing Company, New York. Price $1.

This is an excellent publication for anyone having electrical wiring to do. It is much more than a collection of tables, the arrangements being described and discussed clearly and intelligently. Wiring for alternating currents is included, and some of the tables in this section are, we believe, the first to be published. The book is well and strongly bound to endure the thumbing it is sure to receive.

"Steuerungen der Dampfmaschinen" (Valve Gearing for Steam Engines), by Prof. C. Leist. 770 pages, with 391 illustrations. Julius Springer, Berlin. Price, $5.

This work is another of Springer's superior productions, which are so well known. Its author occupies the chair of mechanical engineering at the Charlottenburg Polytechnic (Berlin); this insures the accuracy and completeness, as well as practical value, of the work. It includes descriptions and demonstrations of all valve gears and motions down to the present time, although to an American engineer it may seem that the subject of shaft governors does not receive as complete a treatment as the subject might appear to warrant. This is probably due to the fact that shaft governors are not in such general use abroad as in the United States. The book is an excellent example of the thoroughness with which the Germans do these things.

"Hydraulic Power Engineering." By G. C. Marks. 369 5¼x7¾-inch pages, with 201 illustrations. D. Van Nostrand Company, New York. Price $3.50.

This is a very thorough and excellent treatise and covers a field in which published information is very meagre. It might have a more descriptive title, as one would be justified in supposing its field to be that of water power development. While water wheels are discussed, its main object is to cover the uses of water under pressure in industrial works. The readiest way of conveying an idea of its scope is to give some of the leading chapter headings. Among these are the following: Packings for Sliding Surfaces, Pipe Joints, Controlling Valves, Platform Lifts, Cranes, Accumulators, Presses, Forging Machinery, Riveters, Pumps. All these chapters are fully illustrated with sectional drawings, and while a free but not burdensome use of mathematics is made, the information conveyed is of the most practical character. The book is of English origin.

"Condensers." A series of lectures upon the subject, reprinted from the columns of "Power." 79 6x9-inch pages, with 33 cuts and 13 tables. The Power Publishing Company, World Building, New York. Price 50 cents.

This is a very complete piece of work by the editor of "Power," in the special field of that valuable journal. The book is absolutely without padding. It contains a concise account of all matters pertaining to all styles of condensers, and not only those interested in the steam engine, but those also who have the making of books might take valuable lessons in condensation from it. The general steam problem, the saving by the use of the condenser, the conditions under which the condenser may not be used with profit, the various types of condensers for different lines of service, their construction and operation and capacities required, are all discussed in terms that any intelligent mechanic can comfortably follow. The book will be valuable not only to the seeker of general mechanical information, but also as a book of reference for the practical steam engineer.

The United States postal authorities are at the present time calling attention to the matter of short-paid letters. This is of special importance now in view of the increased correspondence due to the Paris Exposition. The letter rate is 5 cents per ½ ounce on foreign mail, and deficient postage is charged double. Many foreign houses have standing orders to refuse all underpaid mail matter, and much inconvenience and uncertainty results from negligence in this matter. Another cause of delay and loss of letters is the use by Americans of written characters unfamiliar to French, German and other postal employees. All envelopes should be addressed by a typewriter or by a pen in imitation of printed letters.

It is reported from Los Angeles, Cal., that the local Edison Electric Company will supply to Santa Ana electricity generated by Santa Clara River power in the San Bernardino Mountains, 100 miles away. Electricity from the same source has been transmitted eighty-three miles to Los Angeles.

Commercial Review.

NEW YORK, SATURDAY EVENING,
April 7, 1900.

EXPORTS OF MACHINERY TO EUROPE.

Unquestionably the facilities for producing machine tools in this country have been vastly increased in the last two years. The expansion, which has been most notable in the Middle West, has come partly from the inauguration of new enterprises, but especially through the enlargement of old ones. Without actual computation from complete data, the percentage of increase could not be named with confidence, but to learn that it amounts to one-third, or even more, would occasion no surprise. That the condition through which this increase took place—business seeking the manufacturer—will last forever is not to be expected; under the laws of germinant competition in every fertile field, it could not. The manufacturer must, sooner or later, be doing business again under normal conditions and be forced to use his wits to dispose of his surplus output. Already there are signs that manufacturers discern this prospect and are looking out into new markets. It was with this end in view that a tool manufacturer recently made a tour of the Southern States. The same policy ought to lead to a revival of interest in the export field, and there are some indications that it is doing so.

There has been more or less talk of quietness in exports of machine tools for some time past, but a good business in that line is being done by representative firms notwithstanding. The approximate shipment compilations by the Bureau of Statistics, which we publish this week, show that $585,854 worth of metal working machinery went abroad in February, which was only $1,000 less than in January, notwithstanding the shortness of the month, and 35 per cent. better than February, 1899, which, however, chanced to be a month of unusually light shipments, and was atoned for in March. The banner month was December, 1899, with $748,654 to its credit.

These Governmental export figures show a rapid picking up of late in stationary steam engines, a line of machinery which fell off at the time machine tools were increasing. Since the first of last July the shipment of 739 engines, valued at $420,013, has been accounted for, as compared with 319 at $195,209 for the corresponding period a year earlier. The average value of the engines here comprised is about $600, which induces the suspicion that some of the big electric railway units have been left out.

Shipments to Europe this week have included a notable aggregate of heavy tools by Schuchardt & Schütte. Outside of their shipments of an ordinary nature were two 60-inch G. A. Gray planers, and among several Bement-Miles machines two 10 to 16-foot extension boring mills; also three Bullard boring mills varying from 30 to 60 inches, and two carloads of Gisholt lathes. The destination of these machines is Germany, Austria, Stockholm, etc. We learn that the firm has lately sent over some very satisfactory fresh orders.

In a few weeks a large hinge making plant is to be shipped to Russia by Markt & Co., Ltd. It will comprise a little over $20,000 worth of special machinery for that purpose built by the Waterbury-Farrel Foundry and Machine Company and the F. B. Shuster Company. Within a few weeks past the firm has opened new stores for machine tools exclusively in Manchester and Berlin, in each of which a stock of machines will be carried. Whether owing to general business conditions or to this extension of facilities, their business in this line is maintained in good volume.

Foreign trade conditions are thus observed by the United States Export Association: "Of late there has been a noticeable inquiry for crude iron, coal, automobiles and lumber. The coal demand is particularly from France and the Scandinavian countries. Last week an inquiry came from Amsterdam for 5,000 tons. The scarcity is not abating, and since the use of that combustible for industrial purposes is far beyond comparison with its employment for heating, the coming of warm weather cannot be depended upon to relieve the shortage. The Transvaal war increases the demand for coal, but it is thought that if America begins now to ship coal to Europe it will act as an entering wedge, and the traffic will continue after the war is over. We have not ourselves noticed that as a result of the coal shortage upon foreign manufactories any orders for engineering materials have been directed to America.

"There is considerable foreign call for American automobiles, in spite of the fact that the industry is being taken up quite extensively in Belgium and Germany. The inquiry comes especially from France and Germany. They are more particularly interested in American electric vehicles, as they have the gasoline at home and regard the minor applications of electricity as distinctly an American art.

"As usual in the spring, there is a demand for agricultural machinery for Southern Russia, the present season apparently being quite a satisfactory one. It is reported that some of the American manufacturers are to keep open stores in Paris during the Exposition so as to be able readily to meet the demand that they hope will result from their exhibits at the fair."

Fenwick Freres & Co. have closed a contract with the Hill Tool Company, Anderson, Ind., for a general agency on their line of tools. A full line of tools for stock is being sent, and the French firm will carry a complete line of them at all times.

MISCELLANEOUS.

In machine tools, and generally in machinists' supplies, values are still coherent. That prices have attained their topmost poise is a well-recognized fact; the question is how long they will stay there. It is said that some of the smaller tool builders show prospect of softening before the year is out, and that the occasional easing off in cost of castings tends to push out a prop from the market, but these influences have as yet made no perceptible progress. With all the growing rapidity of deliveries the leading makers are still requiring four or five to seven months. A lathe manufacturer with whom an order for about three dozen 14 to 20-inch lathes for export was placed last September has thus far delivered only a part of them, and is not expected to finish their execution till some time in May.

The General Electric Company has secured a controlling interest in the stock of the Siemens-Halske Electric Company of America. The latter has been building a good many automobile motors, and it is said to be probable that this feature will continue under the new ownership. The sales of the General Electric Company, which amounted to about $27,000,000 for the last fiscal year, have started out in the present one to go several millions ahead of that figure.

The New Jersey Machine Works have received an order for about fifty gasoline motors from the Smith Motor Company, of Newark, N. J., manufacturers of automobile and bicycle motors.

The American Gas Furnace Company has just booked an order for a quantity of apparatus to be installed in the United States Mint at New Orleans. It comprises an oil gas machine with pressure blower, two annealing machines, rotary pressure blower, etc., amounting to about $6,000. Not long since the company received an order for heating apparatus, including a gas plant, for the new mint at Philadelphia. The various Westinghouse manufacturing companies—Electric, Air-Brake and Machine—have lately been customers, and the Weston Electrical Instrument Company has ordered for its shop at Waverly, N. J., an outfit comprising a gas generator and heating appliances. The equipment of the new plant of the Mobile Company of America has been furnished with an outfit of machines of the same make. Trade conditions are favorably indicated in the current business and outlook of the American Gas Furnace Company, the general situation showing, from their view-point, no tendency to weaken. March trade was even slightly better this year than last. The present month exhibits a more striking increase, which is due, however, to the fact that contracts which have previously been pending happen to be closed up just now.

The Webster Manufacturing Company has the contract for a complete conveying, elevating and power transmitting machin-

ery equipment for a cement plant at Sydney, New South Wales.

The Hicks Gas Engine Company, Buffalo, N. Y., writes: "Orders are coming in for the Hicks engine in a most satisfactory way. Among our recent orders are two 30 horse-power gasoline engines to operate the Ridgefield water works, Ridgefield, Conn.; one 25 horse-power gas engine for electric light duty, St. Louis, Mo.; one 30 horse-power gas engine for electric light plant, Buffalo, N. Y.; one 50 horse-power gas engine to operate an electric light plant in the Shelby Steel Tube Company's works, Beaver Falls, Pa. Our works are running night and day on orders."

The International Smokeless Powder and Dynamite Company, Sayreville Junction, N. J., has recently been seeking bids on dehydrating presses, preliminary presses, mixing presses, finishing presses, intensifiers, acid tanks, wringers for drying gun cotton and some other machines. At least two concerns in Newark, N. J., let the contract go on account of deliveries, which were forty-five days at the outside.

CINCINNATI REPORT.

All eyes are turned just at this juncture on the efforts of the labor agitators to bring about different conditions in the many machine tool, wood-working and similar shops in the city. It is at this writing just on the eve of the attempt, which has been simmering for several weeks, to stir up a strife like that which has disrupted Chicago and Cleveland. A mass meeting is to be held to-morrow (Sunday) in Workmen's Hall. A president of one of the largest machine tool making concerns in the country, a gentleman who has watched carefully every move of the effort, says in answer to a query: "The men throughout the city are in good humor. I have every reason to believe they feel perfectly satisfied, and my candid impression is that the coming effort to stir up trouble will be fruitless."

On the other hand, workmen have just received a circular, some extracts of which follow: "As spring approaches, the necessity of the machinists of this city to better their condition is evidently apparent. In order to accomplish this it becomes necessary for all machinists to further unite their forces. . . . The machinists all over the country have bettered their condition and are working eight and nine hours per day, while you in Cincinnati work ten, twelve and fourteen hours per day for less money than they receive. Do you want this condition changed? If so, attend the meeting on Sunday, the 8th. Good speakers will be present."

As for trade conditions, they are not yet materially affected. Eighteen large lathes formed a single shipment from one of the large concerns here this week to Europe, and all the establishments are bending every effort to getting out work ordered early in the year.

There is considerable activity in the field which furnishes electric power apparatus. The General Electric Company and the Westinghouse people are both filling heavy orders for large generators. A number of the larger establishments which belong to the Norwood colony are about ready for their power apparatus. The immense plant of the United States Playing Card Company is receiving bids for the installation of its machinery for light and power. The inadequacy of the foundry facilities is as painfully apparent as ever; castings for cored work are subject to long and irritating delays, and there is said to be a well-defined project on foot to build an immense foundry—a scheme conceived by several of the larger manufacturers using much work of this character.

CHICAGO MACHINERY MARKET.

One of the largest manufacturers in the West has sold a greater number of engines during the past month than for any similar period in a year. Most of them were of moderate size, running, say, from 100 to 300 horse-power. This manufacturer is farther behind in his orders than he was a month ago. Other reports are to much the same effect. Trade has been excellent. Most of it has been from manufacturers—of various classes. The large work is not quite so overshadowing. Municipal lighting plants are fairly well in evidence, though the late prevalence of spring elections temporarily shelved many projects of this kind, to be revived when local political matters settle down.

There is also a large amount of power equipment work in prospect. Some factors in the trade are of the opinion that inquirers are more cautious in closing for their contemplated improvements. The machinists' strike in Chicago has been settled, and almost the normal degree of activity has been restored in the shops. It is further believed that locally no further interruptions to steady operations are to be anticipated from that cause. But in some other lines of manufacture there is an element of uneasiness, and until the situation grows clearer manufacturers are inclined to proceed with an unusual degree of carefulness. This is the explanation suggested for the note of hesitation which is discerned by some. Otherwise, so far as general business conditions are concerned, the situation is very satisfactory.

For high grade engines deliveries can be obtained in about three months for from 100 to 300 horse-power units; in six to nine months for from 500 to 1,000 horse-power; and from a year to fifteen months for 1,000 horse-power and larger. One transaction is now pending for a large unit, the delivery of which is not promised before December, 1901. Intendant purchasers, especially for the larger engines, are becoming more familiar with the delays in deliveries, and are disposed to purchase more generally for remote shipments.

The E. P. Allis Company has sold to the Cincinnati Edison Electric Company two vertical cross-compound condensing engines of 1,800 horse-power, best economy, but guaranteed to stand a continuous load of 2,600 horse-power each. This company has made numerous other sales during the past few weeks.

Boiler trade is equally active. The Abendroth & Root Manufacturing Company has sold a 300 horse-power horizontal water-tube boiler to the city of Fremont, Neb., for lighting plant. Among recent sales of Wickes Bros. are the following: Two 250 units to the Dow Chemical Company, Midland, Mich.; seven 250 units to the Port Huron (Mich.) Salt Works; three 150 units to the U. S. Mining Company, Bingham, Utah, and two 200 horse-power units to Hendricks Bros., New York—all vertical water-tube boilers.

Quotations.

NEW YORK, Monday, April 9, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons:

No. 1 X foundry	$22 95 @ $23 70
No. 2 X foundry	21 95 @ 22 70
No. 2 plain	19 95 @ 21 00

Alabama Irons:

No. 1 foundry	22 25 @ 22 75
No. 2 foundry	21 25 @ 21 75
No. 3 foundry	20 25 @ 20 75
No. 1 soft	22 25 @ 22 75
No. 2 soft	21 25 @ 21 75
Foundry forge	19 75 @ 20 25

It is understood that some of the Northern furnaces which hitherto have been holding their irons a little high have come down to prices more in conformity with others.

Bar Iron — Base sizes — Refined, mill price on dock, 2.05 @ 2.15c.; store price 2.40 @ 2.50c.; common from store, 2.30 @ 2.40c.

Tool Steel—Base sizes—Standard quality, 7 @ 8c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel—Base sizes—Ordinary brands from store, 2.70 @ 2.85c.

Cold Rolled Steel Shafting—Base sizes—From store, 4 @ 4.25c.

Copper—Lake Superior ingot, 17¼ @ 17½c.; electrolytic, 17 @ 17¼c.; casting, 17 @ 17¼c.

Pig Lead—Wholesale lots, 4.70c., New York delivery; carloads, 4.72½ @ 4.77½c.

Pig Tin—In 5 and 10-ton lots, f. o. b., New York, 30¾c.

Spelter—Prime Western, 4¾ @ 4⅞c.

Antimony—Cookson's, 10.90 @ 11c.; Hallett's, 9¾c. for one cask and over.

Lard Oil—Prime City, present make, in jobbing lots, about 60c.

The New Works of the Gisholt Machine Company.

A year ago or more the Gisholt Machine Company, of Madison, Wis., found their old works too small for their business, and decided to erect an entirely new plant, which, except for the foundry, has been done, and is now occupied and in running order. The foundry is now in course of construction, and will be ready for use early in the coming summer. The plant as laid out is, of course, the outgrowth of the experience gained in the old quarters as to the needs of the business, and is an excellent illustration of the marked tendency at the present time to provide an abundance of light, with all needed facilities for handling work, as well as sanitary and other conveniences and comforts for the employees.

FIG. 1. GENERAL VIEW OF GISHOLT MACHINE COMPANY'S WORKS.

Fig. 1 is an exterior view of the works, the two-story office building occupying the foreground, with the main shop building immediately behind it to the left. The upper floor of the office building is occupied mainly by the drawing office, of which we give an interior view in Fig. 2.

Fig. 3 is a plan of the entire plant, and shows the disposition of the various buildings, together with the locations of the various departments and classes of tools. A section of the machine shop is shown in Fig. 4. The monitor portion of the roof will be seen to be unusually high, and as it is practically one continuous window, and the same is true of the side walls, the lighting effect is correspondingly superior. We have, in fact, seen nothing better in this respect anywhere. The provisions for warming the buildings are on the blast system and on the same liberal scale. Our visit to the works was on an unusually cold and windy day, even for that section of the country, and the works had a perfectly even and comfortable temperature everywhere. As the weather is at times very severe, double windows are used throughout. The foundry will be of the monitor roof construction, the wing on one side being of one story and on the other of two stories. The buildings throughout are of brick, and the structural work of the shop proper is of steel. Practically the only wood about the building is that in the roof, the window and door frames and the floor, the danger from fire being thus reduced to a minimum. The roof is made of two courses of matched boards, the lower course being 1½ inches and the upper 1 inch thick, with building paper between the courses. The roof is covered with heavy fireproof roofing and is painted on the inside, as are also the walls, with white fireproof paint. The construction of the roof makes it much easier to keep the shop warm in winter and also serves to make it cooler in summer. The floor consists of planks which rest on oak stringers which are bedded in cinders, the ground under the entire shop having been covered with cinders to the depth of about 6 inches before laying the stringers.

The side of the shop nearest to the office is used chiefly for erecting, the opposite side for the machine work. In the part of the shop that is traversed by the crane are located the heavy machine tools, and this part is also used for the final assembling and testing of machines. Machines of the same type are grouped together, and each group is driven by a separate motor. Several groups of these machines are shown by the cuts herewith, one of which, Fig. 7, will show that the Gisholt Company takes its own medicine in large doses. A few of the heavier machines are driven

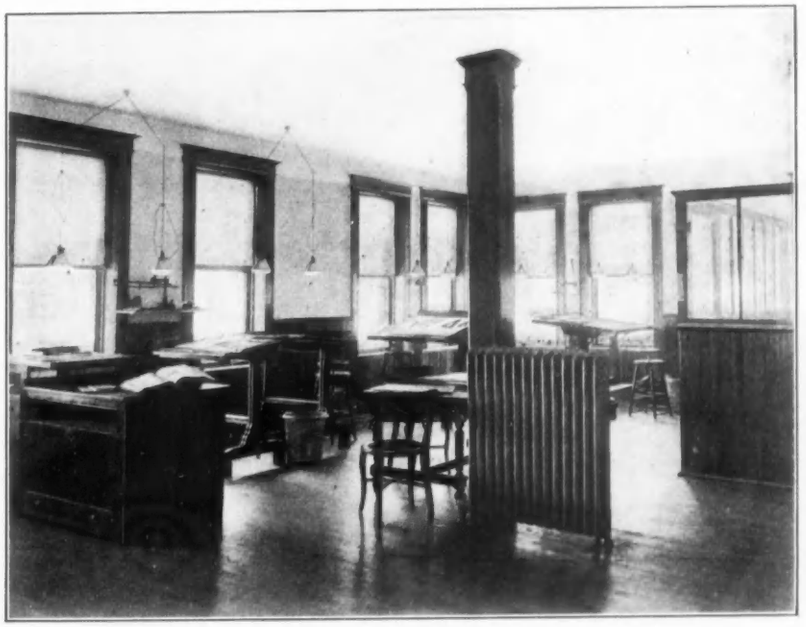


FIG. 2. DRAWING OFFICE.

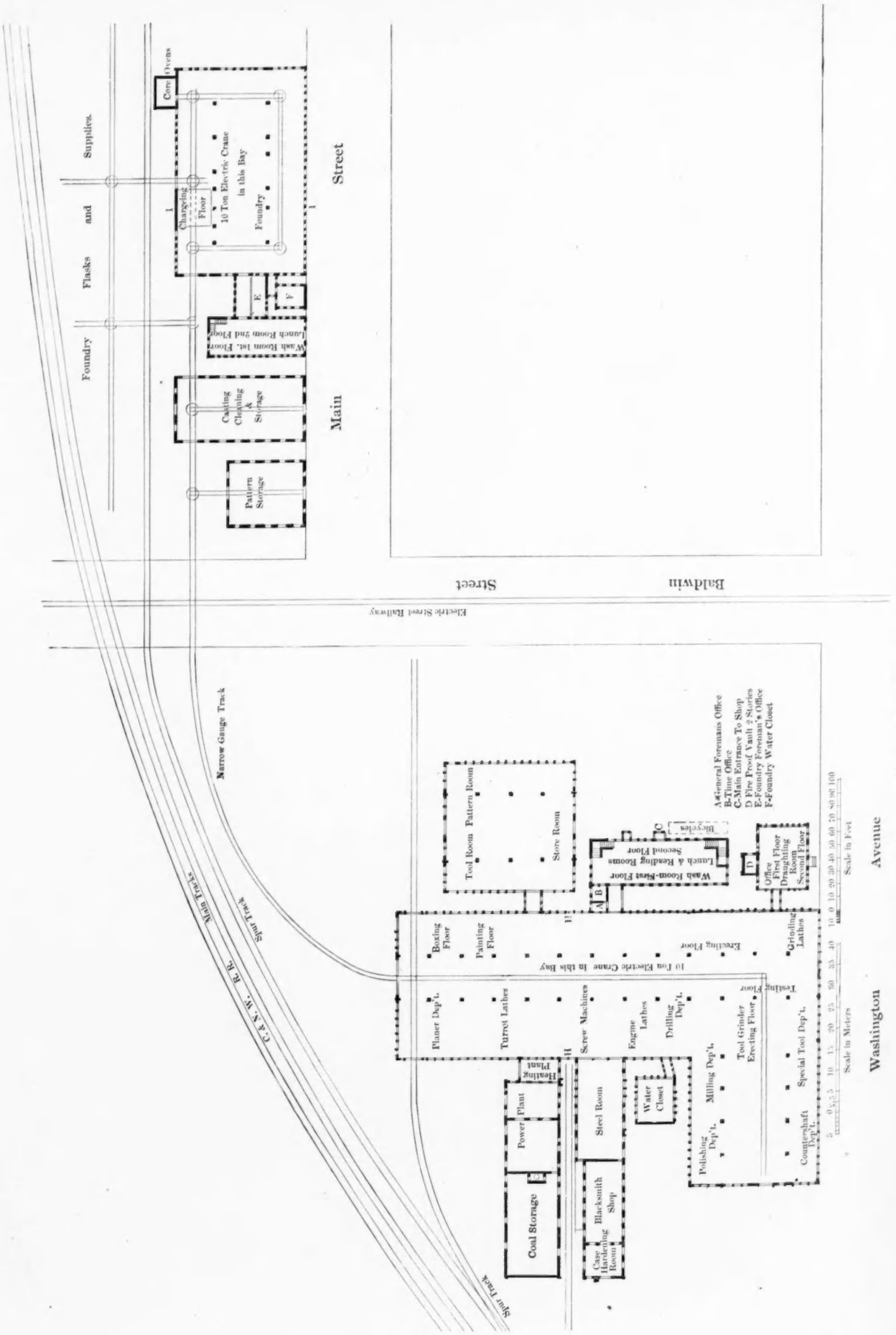
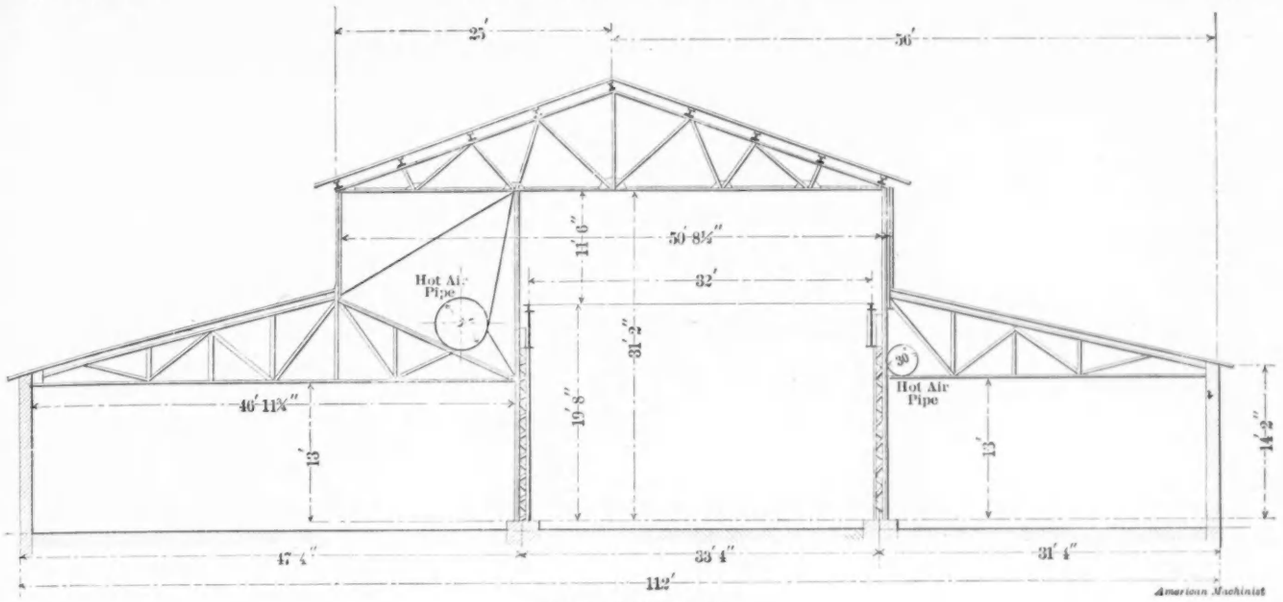


FIG. 3. GENERAL PLAN OF PLANT.



Section H-H Main Shop.

Fig. 4

by independent motors. On the erecting side the work is divided so that all headstocks are erected in one place, feed works in another, carriages in another, etc. These parts are finally assembled in the main aisle, where they can be handled by the electric crane which traverses the entire length of the shop. A spur track passes through one end of the shop, so that machines can be loaded directly on the cars with the crane.

The shop is equipped with a large number of special machines and special jigs for the rapid and economical production of the machines manufactured by the company.

The building in which the steel is kept is located on a spur track, so that the steel may be unloaded on a platform and run directly into the steel racks. The screw machines are so located that bars can be

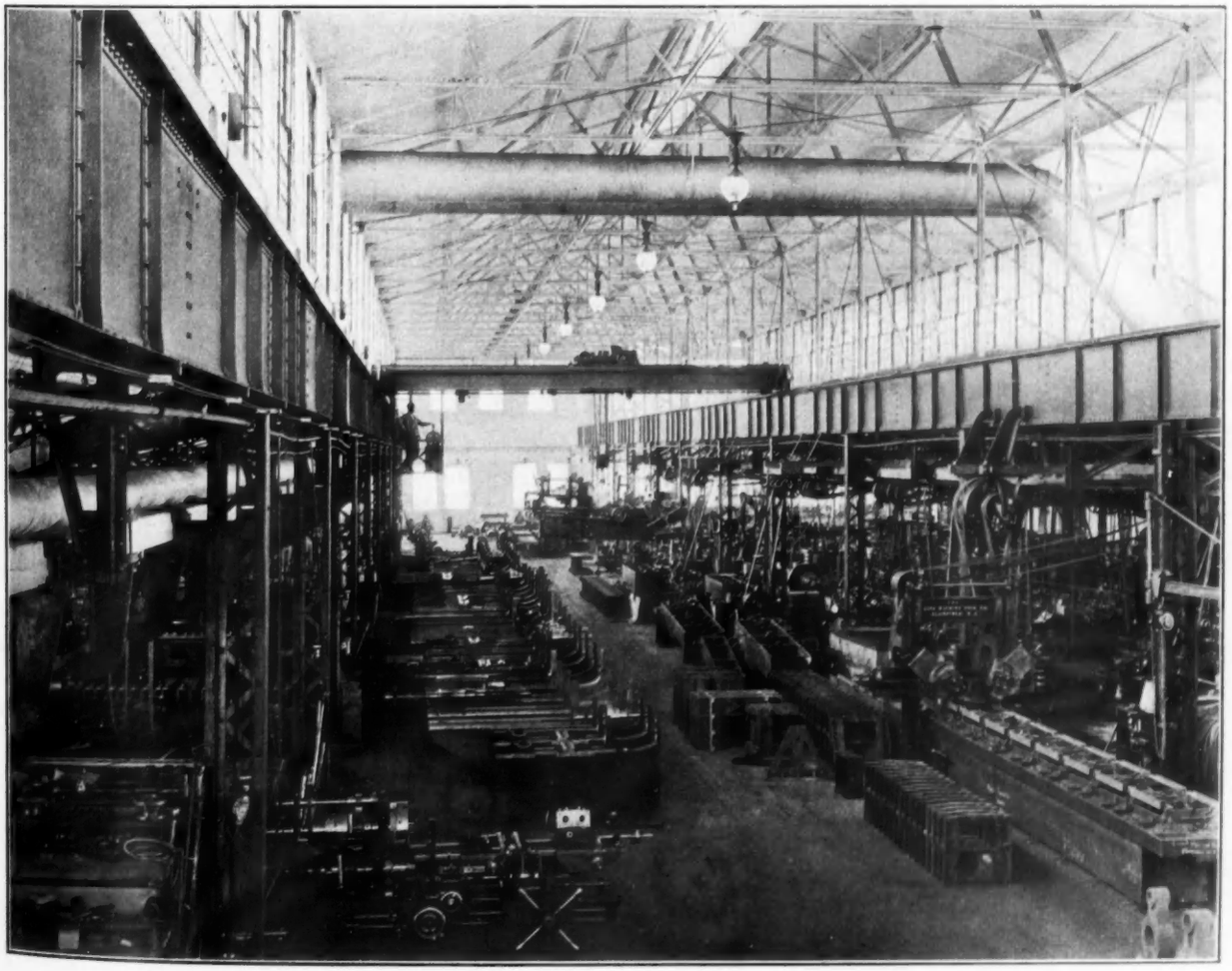


FIG. 5. ONE END OF MAIN AISLE.

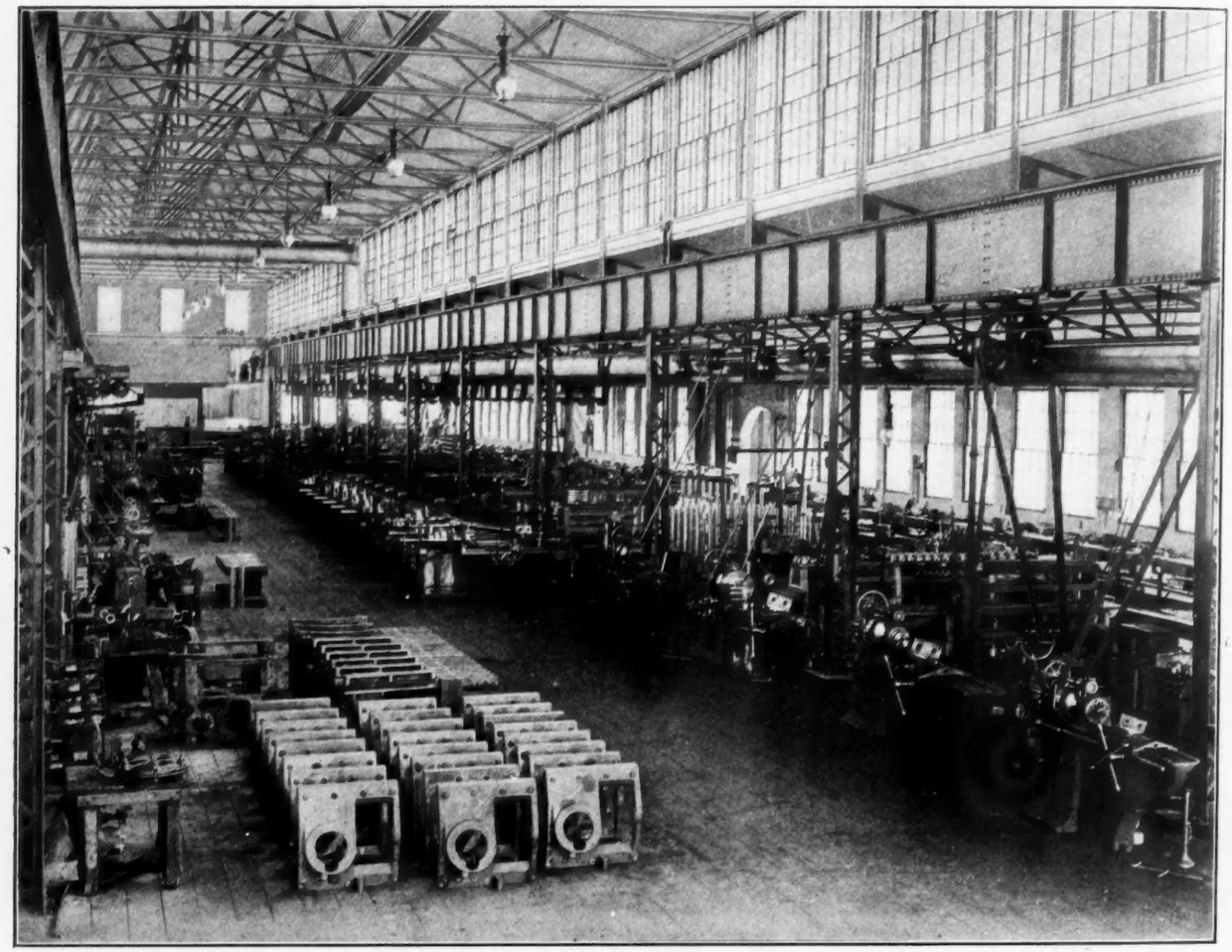


FIG. 6. OPPOSITE END OF MAIN AISLE.

FIG. 7. TURRET LATHE DEPARTMENT.

run directly from the steel racks into the machines. The blacksmith shop, shown in Fig. 11, is equipped with down-draft forges, shears, power hammer, etc. The power plant at present consists of two horizontal water-tube boilers, equipped with mechanical stokers, and two engines direct connected to the generators. One engine is used for power, the other for light, and also as a reserve for power. The current for all of the power and light circuits is controlled from the switchboard in the engine room.

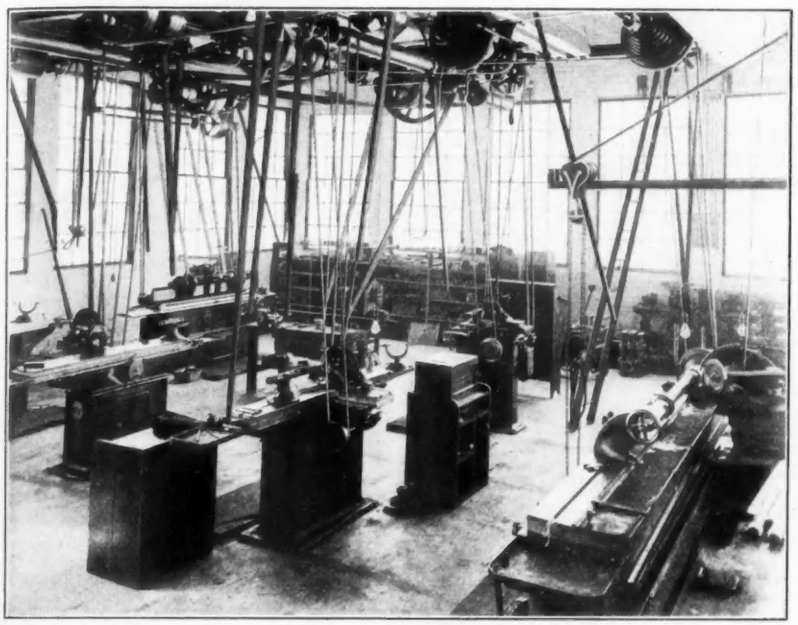


FIG. 8. GRINDING DEPARTMENT.

Flushing closets and urinals are provided for the men, and the system used insures their being kept clean and free from all obscene defacings. The closets are kept locked, and to get in them keys must be obtained from a man whose sole duty it is to look after the closets and urinals. A record is kept of the men who use the closets, and if workman A finds that a closet has been defaced in any way he is expected to report it immediately. Failing to do this if workman B following finds and reports the closet out of order, workman A must either put it in order or pay for having it done.

The main entrance to the shop is through the washroom, shown in Fig. 12, where individual, thoroughly ventilated lockers are provided for each man. Hot water is supplied for washing. In this room there are also twelve shower baths which may be used when desired. The second floor of this building, shown in Fig. 13, is used principally as a dining room, but it is also used from time to time for lectures and entertainments,

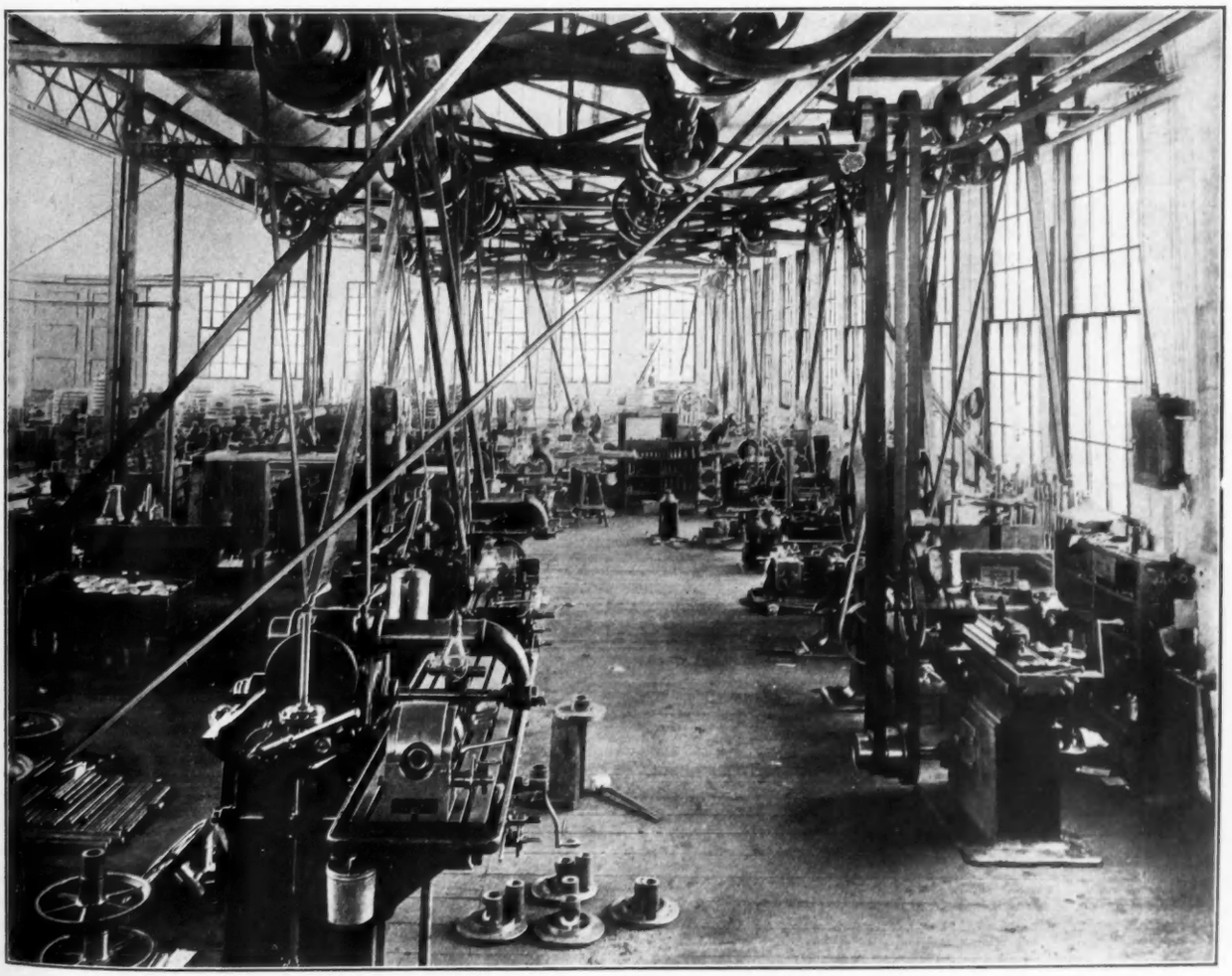


FIG. 9. MILLING DEPARTMENT.

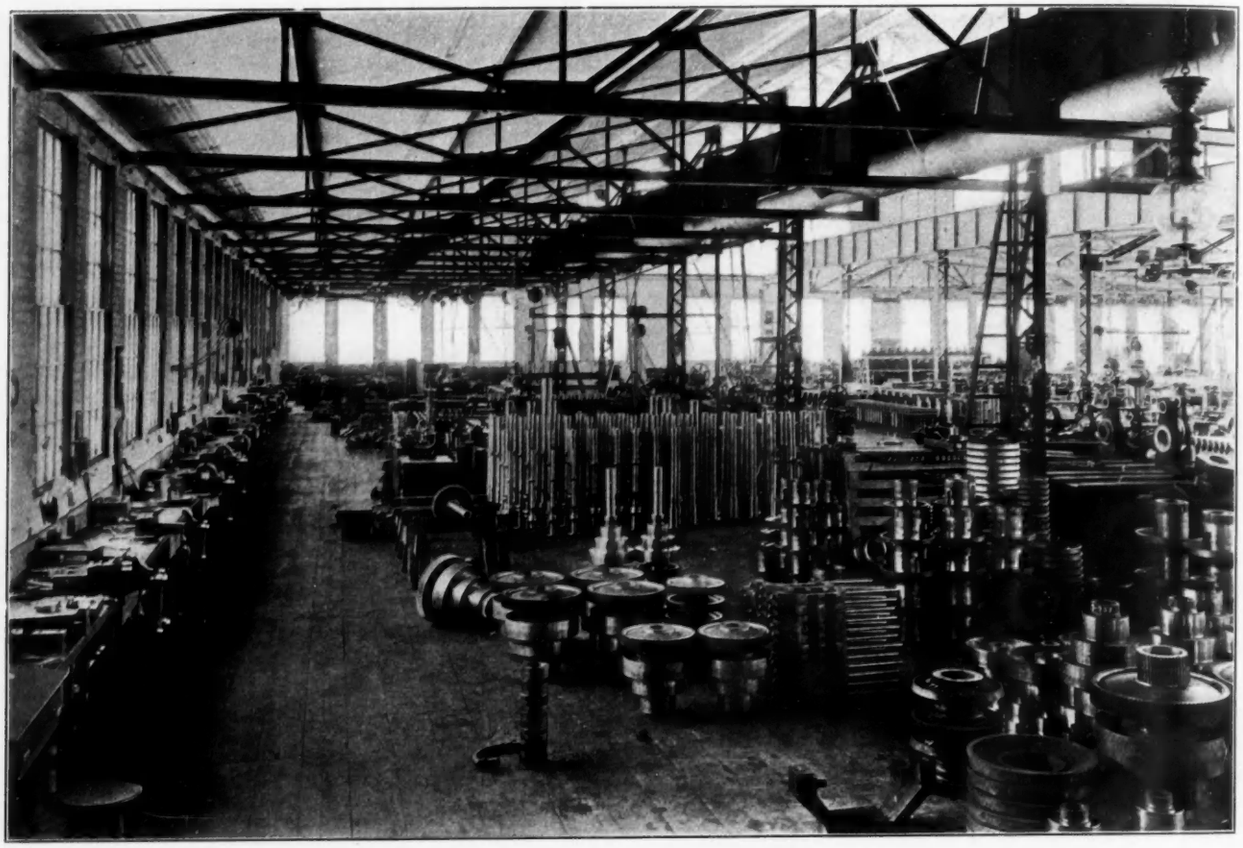


FIG. 10. HEADSTOCK ASSEMBLING FLOOR.

which are given under the auspices of the Gisholt Library Club, an organization composed of men employed by the company. The dining room, when arranged for an entertainment, will seat 500 people. The Library Club is run entirely by the employees, the company having placed at their disposal a reading room, which adjoins the dining room. This reading room is kept open evenings. The company furnishes about twenty-five newspapers, magazines, etc., which are considered the property of the club. The dues of each member are ten cents a month, but the money collected belongs to the club and is used by it as the members see fit.

In connection with the foundry now in course of construction there will be the building in which the lower floor will be equipped with shower baths and the upper floor arranged as a dining room.

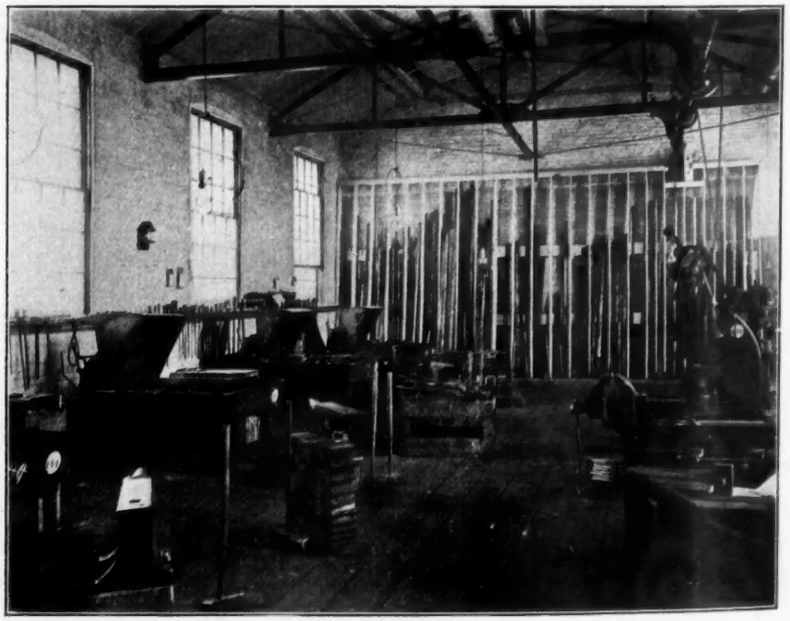


FIG. 11. BLACKSMITH SHOP.

The Chemistry and Physics of Cast Iron Briefly Considered—II.

BY J. E. JOHNSON, JR.

When cast iron contains comparatively little of other elements than carbon, its actions are comparatively simple and are approximately those outlined very briefly in the previous article, but commonly it contains several other metalloids in appreciable quantities, and if this article is to be of practical use, as the writer hopes it will, some account of their individual and collective actions and effects is necessary.

Next to carbon in quantity and importance in nearly all commercial irons comes silicon. One of the principal effects of silicon is to prevent the iron from absorbing so much carbon, and especially from retaining it in solution at lower temperatures; so that as irons contain more silicon, they can contain less *combined* carbon, and are therefore less hard under all circumstances, or rather, more incapable of being hardened. The silicon is undoubtedly dissolved in the iron, and probably combined with it chemically, as is the carbon also at high temperatures when they are melted, but is forced out as the temperature falls. This is analogous to the action of double solutions. For instance, if calcium chloride and common salt be dissolved in hot water, and the solution

evaporated down until concentrated and then allowed to cool, the salt will practically all be thrown down and the calcium chloride remain in solution. Silicon is supposed to increase fluidity, but it seems to the writer probable that its principal action is in forcing out the combined carbon and so raising the melting point by making the iron (in a sense) more like steel,

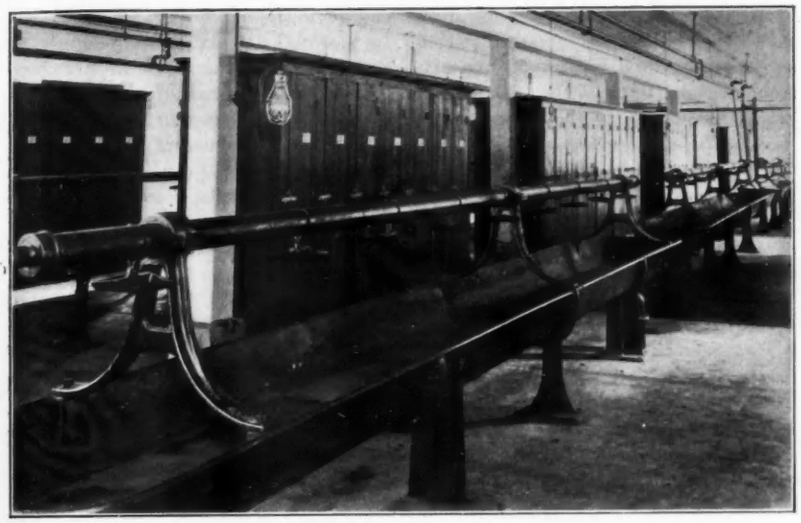


FIG. 12. WASH ROOM AND LOCKERS.

and that the consequent necessity for increased heat-absorption to melt the iron gives it a greater heat-reserve and makes it more fluid in that way, rather than by any direct alloying action. Certain it is that iron very low in silicon, if made in a hot furnace, has a fluidity like that of quicksilver and far beyond that of the ordinary high-silicon iron.

The effect of silicon upon strength is complicated and depends upon many things. It is claimed to be a strengthener for small sections and up to a certain limit, but it is certain that above 2 per cent. for ordinary work it is a weakener, the "silver-gray" irons and ferro silicon which contain from 4 to 10 per cent. of it being utterly "rotten." One of the notable things about silicon is that in the amount of it present for a given grade, consists the chief difference between charcoal and coke iron, the charcoal iron containing vastly less than the coke. This explains why charcoal iron differs so materially from coke iron made in the same way in every respect, except the fuel. The charcoal iron having very little silicon, the amount of carbon dissolved in the iron is large, and a good deal of it goes into the combined form, while still sufficient is left to form some graphite and give toughness as well as strength.

Until very recent years furnacemen could not control their furnaces so closely as to make a coke iron low in silicon and sulphur at the same time, since the conditions for keeping both down are largely conflicting; so that when a tough, strong, chilling iron was needed, charcoal iron was largely used; but now a first-class furnaceman can make, with coke, an iron which will not differ appreciably in its chemical or physical characteristics from charcoal iron, and the latter is destined to a gradual decline, which it is now in fact undergoing, and has been for some years.

A very interesting suggestion was recently made to me by Mr. Macamson, chemist of the Chattanooga works of the Southern Pipe & Foundry Company, which was entirely new to me, though it may not be so to others. It was to the effect that the greater part of the silicon in coke iron might come from the ash of the coke, which is mainly silica, and that if this were so it would account for the low silicon contents of charcoal iron. This suggestion has features which bear very close examination well. We know that the most intense heat of the furnace is required for the reduction of silica to silicon, and that this is only to be found immediately at or near the level of the tuyeres, while the silica of the ore and of the burned portion of the coke, having been in intimate contact with the lime since they left the top of the furnace, or soon after, has very probably been taken up by the lime and converted into slag, from which it would not be likely to be reduced, while the portion of the coke which comes down to the tuyeres still unburnt exposes its contained silica under the most favorable circumstances for being reduced, and in position to be washed off the coke and absorbed by the melted iron in its descent, gradually, as the successive portions of silica are exposed by the burning away of the coke.

It is immediately in this region also that the cyanides are known to exist which are held by Mr. Bell to be probably concerned in the final reductions. It is a fact also that a much greater proportional quantity of coke is used for making high-silicon than for low-silicon iron, which points strongly the same way. Sulphur is, quantity for quantity, the worst element occurring in cast iron. It is in itself a hardener and probably acts on the carbon to keep it in the combined state as well. It is commonly the result of a "cold furnace," since heat not only tends to drive it off, but the investigations of a French scientist, within a few years, show that high-sulphur iron melts more readily than low-sulphur iron, which would be expected if the sulphur acted to throw the carbon into the combined state, so that if the furnace gets cold, the effect is double; the iron absorbs sulphur, which enables it to melt at the low temperature. Sulphur increases shrinkage, and undoubtedly also causes blow-holes, and except for the trifling fact that it increases strength, is a detriment in every way.

FIG. 13. DINING ROOM.

Sulphur comes almost entirely from the coke. Some ores which carry much sulphur require roasting before going into the furnace, to drive it off; but by far the greater part of the ores now used are free

from it to a great extent. Good coke, however, always contains somewhere from .5 to 1 per cent., and bad may contain up to 3 per cent., or more. The almost complete freedom of charcoal from this element is one of the reasons which make it easy to produce with that fuel a tough, strong iron, for the conditions for the control of sulphur and for that of silicon are largely antagonistic, and being almost wholly rid of both at the critical point, assuming Mr. Macamson's suggestion to be right, it was easy, even in the days before chemists, to produce an iron which was largely an alloy of iron and carbon, pure and simple, and correspondingly strong and tough, especially where the phosphorus happened to be low.

The danger from sulphur is not over when the iron is made, as far as the foundryman is concerned, for in remelting the iron with coke it is certain to absorb some sulphur even with good coke, and may take up a ruinous amount from bad, and when a founder begins to have trouble from hard castings, blow-holes on the top surface, and heavy shrinkage, he had better have an analysis of his coke made before he goes after the furnaceman, "hunting trouble."

Phosphorus is an element which is probably more condemned than it deserves in cast iron, although in steel it is fully as objectionable as it is commonly considered to be. Its effect is the same in both, and may be best expressed by saying that it makes the metal treacherous. In steel which requires to be as nearly absolutely reliable and certain in its behavior as it can be made, this is the worst quality possible; but cast iron, being inherently and necessarily an uncertain, not to say treacherous, metal *anyway*, the slight addition to this quality caused by phosphorus in moderate quantity may be more than offset by its other effects. One of these undoubtedly is to increase the fluidity, and another is to decrease shrinkage. Phosphorus is also a strengthener up to about .5 per cent., as shown by recent tests.

Phosphorus has the effect in chilling iron of causing the white portion to be separated from the gray of the casting by a distinct line, instead of the two being interlaced and changing gradually over a considerable width; and as this last is a necessary condition for a strong, reliable chill, phosphorus to the extent of more than about .2 or .3 per cent. is not to be recommended in a chilling iron, especially a car-wheel iron. This is simply another case in which it tends to make the metal treacherous, and as car-wheels receive the severest treatment of almost any form of cast iron, phosphorus is not allowable in them.

Manganese is an element which is probably blamed sometimes for faults which it does not possess. It is undoubtedly a hardener in either cast iron or steel, and if present to the extent of 2 per cent., or more, may work serious injury; but ordinarily, when not in excess of 1 per cent., it is more of a benefit than an injury, since it has a strong affinity for sulphur and tends to absorb it and slag it off when being remelted. The makers of basic open-hearth steel are very partial to it and desire to have it in the iron to the extent of 1 per cent., when possible, for this reason; and there is no doubt whatever that the same action takes place in the cupola.

These are the elements upon whose presence in the iron *as poured,* and the physical treatment it receives at and after casting, the character of the iron depends *wholly,* irrespective of the previous state it was in; whether chilled or soft, open-grained or close.

I have given here a very brief review of the actions of these elements. Those who desire to obtain more detailed knowledge of the subject would do well to consult a paper written by Mr. Guy R. Johnson and read about three years ago before the Foundrymen's Association at Philadelphia. In it are given analyses and tests of many hundreds of irons containing different proportions of the different metalloids and grouped in different ways. It was, so far as the writer knows, the most complete statement of ascertained facts yet published which concerned itself with practical results mainly. In this the effects of the different elements were stated and illustrated by tables giving the results of a vast number of experiments, and the compound effects due to the variations of two or more elements simultaneously were explained at some length, the whole being undertaken with the view of solving *practical* foundry problems.

Before leaving this very interesting subject I wish to offer a few suggestions to foundrymen, which I hope will help forward foundry practice to some minute degree if followed out.

In the first place, while it ought not to be necessary to say it, the most essential point is to dismiss utterly the old notion, inculcated so thoroughly by the old regime in the foundry world, that everything is mysterious about the business and that the results desired can only be obtained by following traditions long established. The modern proposition to replace this is that the behavior of the iron *in all respects* depends upon its chemical composition and the way in which it is treated at and after pouring, the chemical composition being understood to be that as poured, not as charged into the cupola. There is generally a very perceptible difference between these two. Some silicon is always burnt out, depending on the method of operating the cupola and the quantity of silicon originally present. With good cupola practice and iron containing about 2.50 per cent., about 0.2 per cent. is burned out, and by slow melting, bad arrangement of the tuyeres, etc., this may be increased materially.

Some sulphur is nearly always absorbed, as before stated, the amount depending upon the quantity contained in the coke, the intensity of the heat of the cupola, the lime used and other factors, those mentioned being the most important and named in the order of their importance. This is a matter which varies largely, but on the average it is probably safe to say that to have an absorption of less than .025 per cent. is good practice, and it is on this account more than any other that remelted iron is disliked and the use of sprues and gates condemned where "dead soft" work is desired.

The manganese is apt to be considerably lower if much is present, and this is a good thing, for it means that it has largely gone in the removal of sulphur, and both being hardeners, the effect is undoubtedly beneficial.

The reduction of the quantity of manganese depends upon various factors, and the writer does not feel able to give any figures for it that would be even an approximation in the general average case, but as small quantities of manganese do not, of themselves, affect the character of the iron very greatly, this variation is not so important as the others.

The variation of the phosphorus is, in good general practice, negligible. None will go out, and with decent coke very little will enter the iron. The amount of the variation in total carbon is very variable and depends largely upon the method of melting. Some carbon is always burnt out in melting pig iron, and it is probably safe to say that it is always the graphitic which goes, since, owing to the decrease of silicon and increase of sulphur the combined carbon always tends to increase. Moreover, the graphite is blown away by the blast during melting.

When the iron is melted in the air furnace a large quantity of the carbon is burnt out, and also more of the silicon than in the cupola, with the result that the iron is able to hold most of the carbon in the combined state, so that castings from metal so melted are strong, but not at all flexible. By annealing these, however, with oxide of iron at a high heat the oxide absorbs still more of the carbon from the exterior surface of the casting, and it is reduced to practically wrought iron on the outside.

In general cupola practice, however, probably not over .1 to .2 per cent. of carbon is burnt out.

If, now, a foundryman has a mixture which gives him exactly the results he wishes in his castings, and wishes, for any reason, to get the same results with a different combination of irons, he has only to have an analysis made of the casting which suits him, modify it along the lines indicated to find what the analysis of the mixture previous to melting was, and by simple proportion figure out from the analyses of any given series of irons a mixture that will duplicate it, and he will get the result in his castings every time, unless

some miscalculation has been made or other conditions altered.

The analyses of irons may always be obtained from the agents or the parties making them, and in this connection I would like to state that founders make a great mistake in not regarding the furnace men as their friends rather than their enemies. Most of them will be found willing to help in many ways to the results the foundryman desires, and the idea that they will shove off anything on the customer he will take is all wrong. If foundrymen would go, or write, to them when difficulties arise it would be of benefit to both parties in many cases.

One or two points upon current notions in the business are so practical that I wish to insert them here, as this is intended as a strictly practical article.

One is the idea that the entire virtue of an iron is gaged by the percentage of silicon it contains; the other is that phosphorus is always necessarily an evil, and manganese, to a less extent, the same. The percentage of silicon which exercises any influence on the chilling properties of an iron is soon passed; probably at 1.50 per cent., certainly at 2 per cent., and the influence of the silicon as a *hardener by itself,* as distinguished from its action on the carbon, begins to be felt increasingly after this point is passed. It is doubtful, also, whether it increases fluidity appreciably after this, while it undoubtedly becomes a *"weakener"* as the percentage rises beyond this point.

Moreover, silicon is *the* great dirt producer. Some of it is always burnt out in the cupola; as stated, the oxide of silicon, or silica, so formed is seldom perfectly slagged off, and comes out mixed with iron, from which it separates when given time to rise to the surface, with the results that foundrymen know so well.

Where a large quantity of scrap is to be carried it is considered necessary to have high silicon in the iron, but as the scrap, unless obviously hard, probably contains a fair amount of silicon, it is not necessary to make up any great deficiency, and the use of high silicon has probably arisen from the fact that the scrap is undoubtedly harder, but far more from high sulphur than from low silicon, and the high silicon of the new iron may to some extent act as a neutralizer of the sulphur, but it does not have this effect to more than a limited degree.

Where ordinary good scrap is used and the general run of machinery castings made, it will, the writer feels sure, be better to use an iron of high manganese, 1 to 2 per cent., according to the percentage of scrap to be carried, with only moderately high silicon. This will remove the sulphur or keep it down, and the result desired will be obtained without the evils of high silicon.

Phosphorus is admittedly an element productive of some uncertainty, but is *not* invariably a weakener; on the contrary, at least for small and medium size castings, not chilled, it is a strengthener up to .5 per cent., and its influence on fluidity is enormous. An iron containing silicon, 1 per cent.; phosphorous, 1 per cent., will be vastly more fluid and make far sounder castings than one containing silicon, 3 per cent., phosphorus, .2 per cent., and will have less shrinkage; though 1 per cent phosphorus is not recommended by the writer.

In a general way it is probable that the average foundryman strives to obtain for the general run of work an iron which analyzes roughly silicon, 2.70 per cent.; sulphur, .05 per cent.; phosphorus, .2 per cent.; manganese, .25 per cent.; combined carbon, .15 per cent.; graphitic carbon, 3 per cent.

If instead he would aim for one containing silicon, 1.40 per cent.; sulphur, .03 per cent.; phosphorus, .5 per cent.; manganese, .6 per cent.; combined carbon, .4 per cent.; graphitic carbon, 2.5 per cent., it is the profound conviction of the writer that he would get an iron stronger, equally flexible, and more elastic, more fluid, as easily machined and much easier on the tools, cleaner, indefinitely more steam tight, and with less shrinkage.

These articles have already far outgrown their intended limits, and no more will be said in favor of this contention now; but should any reader do me the honor to ask for proof or illustration I will endeavor to supply it.

Pittsburgh, Pa.

Designing Spiral Wheels for Given Centers.*

BY ROBERT A. BRUCE.

In considering the relative motions of a screw and its nut, it is sometimes useful to reduce the motion to one plane by developing the helical line of contact. The case then becomes one of the relative motion of two inclined planes, the direction of motion being parallel to the base. In a similar manner it is possible to simplify the relative motions of two spiral gears. If the traces of the teeth on the pitch surface are alone considered, these become a number of helices traced on a cylindrical surface. If this surface is developed, we obtain rectangular strips of width equal to the breadth of the wheel, and the traces of the teeth are represented by a number of inclined lines, the whole forming the outline of a rack of the same normal pitch with teeth inclined at the same angle to one of the sides, as are the teeth of the gear to one of the sides of the wheel. By considering the relative motions of two such racks, all of the important questions in designing a pair of spiral wheels of given pitch and centers to fulfill any conditions as to velocity ratio, may be readily settled. In Fig. 1 $B\,B$ represents a spiral pinion and $A\,A$ a wheel with which it gears, the axes being parallel to the plane of the paper and at right angles to one another. The teeth have been indicated conventionally by straight lines, which approximately give the intersections of the front faces of the teeth with the pitch surfaces of the wheels. In Fig. 2 $B\,B'\,S\,S'$ represents a portion of the developed pitch surface of the pinion, and $A\,A'\,T\,T'$ a corresponding portion of the development of the pitch surface of the wheel. The relative motion of the wheel and pinion may therefore be represented by the motion of the two racks $A\,T'$ and $B\,S'$, A moving to a in the same time as B moves to b, and hence the linear movements of the two racks represent the linear movements of the pitch surfaces of the wheels. Now the angle α in Fig. 2 represents the angle between the teeth of the pinion and its axis, and is defined if we know the relative linear velocities at the pitch surfaces. If, therefore, the velocity ratio is known and the diameters of the wheel and pinion are provisionally determined, we can at once obtain the angle α. Fig. 2 will make this point evident, for the angle is evidently determined by drawing a right-angled triangle whose base is $O\,X$ and whose opposite side is $X\,P$. Now $O\,X$ represents some definite portion of the circumference of the pitch surface of the wheel and $X\,P$ represents that portion of the pitch circumference of the pinion which gears with it. Thus if $X\,P$ represents the whole circumference of the pinion, then

$$O\,X = \frac{\text{whole circumference of wheel}}{\text{velocity ratio}}$$

And again, if $X\,P$ represents the diameter of the pinion, then it follows that

$$O\,X = \frac{\text{Diameter of wheel}}{\text{velocity ratio}}$$

It is also clear that if $X\,P$ or $Y\,O$ represents the whole circumference of the pinion, then the line $Y\,N$ divided by the normal circumferential pitch will give the number of teeth in the pinion; or if $Y\,O$ represents the diameter of the pinion, then the length $Y\,N$ = the number of teeth in the pinion.

$$\text{Diametral pitch} = \frac{\text{the number of teeth in the pinion.}}{Y\,N}$$

The number of teeth in the wheel is evidently equal to the number of teeth in the pinion multiplied by the velocity ratio.

The actual method of applying these simple facts to the design of a pair of spiral wheels may be best appreciated by examining an actual case.

Let it be assumed that the axes of the wheels are in parallel planes and at right angles, and let the following conditions hold: Centers of wheels = 5½ inches, velocity ratio = 5 ÷ 2, pitch = 8 teeth per inch of diameter; diameter of pinion to be about 4 inches. Then it follows that the diameter of the wheel may be provision-

*Our readers will observe that the author of the following article uses the term "diametral pitch" in a different sense from that customary in this country. Instead of meaning by that term the number of teeth per inch of diameter, he means the circumferential pitch divided by 3.1416—a quantity that is here sometimes called the modulus. We have thought it best to make this explanation, rather than change the phraseology.—Ed.

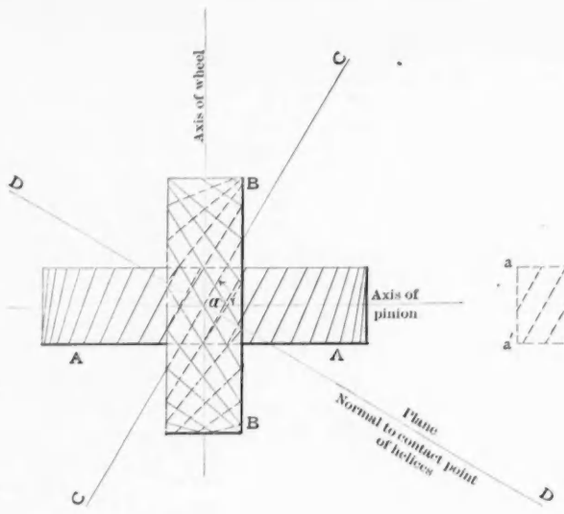


Fig. 1

SPIRAL WHEELS IN GEAR.

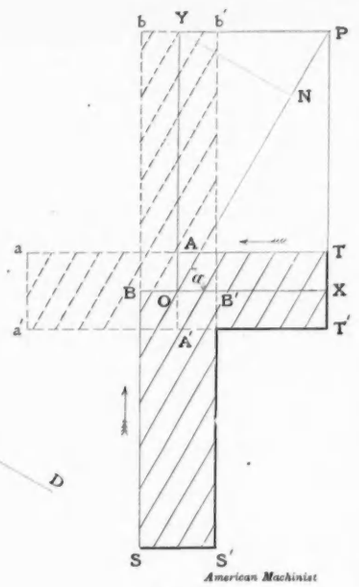


Fig. 2

DEVELOPMENT OF PITCH SURFACES IN TANGENT PLANE TO POINT OF CONTACT OF THE SURFACES.

ally settled at 7 inches. The first question to settle is the suitable number of teeth in wheel and pinion, so as to approximate to the given conditions.

The construction is shown in Fig. 3, where $O X$ is taken to represent the axis of the pinion, and $O Y$ that of the wheel. $O F$ is made equal to the diameter provisionally chosen for the pinion, and $O S$ equal to the diameter of the wheel divided by the velocity ratio of the gears. The rectangle $O F E S$ is completed, and O and E are joined. Then the angle $E O S$ is that between the face of the teeth and the axis of the pinion, and consequently if $F G$ is drawn at right angles to $O E$, then $F G$ divided by the diametral pitch will give the number of teeth in the pinion. Having chosen the diameters arbitrarily, it is of course a pure matter of chance whether the line $F G$ turns out to be an exact multiple of the diametral pitch. In the example before us, we find that $F G$ is about equal to the diametral pitch $\times$ 18.3, so we decide on the nearest whole number, 18, for the pinion, and $18 \times 5 \div 2$, *i. e.*, 45, for the wheel, as the number of teeth most suitable to comply with the conditions. This completes the first step in the solution, and before passing on to the next construction, it may be as well to point out that, had an even circumferential pitch been used, the construction might have been conveniently modified, as follows: Referring to Fig. 3, $A O$ is made equal to the circumference of the provisionally settled pinion, and $O D$ equal to 2-5 of the circumference of the wheel, and the rectangle $O D B A$ is completed. $A C$ is now drawn at right angles to $O B$. The length $A C$ divided by the circumferential pitch will now give as the number of teeth 18.3, as before. Secondly, had the axes been inclined at any other angle, the construction would have taken the form shown in Fig. 5, where $F O$ is perpendicular to the axis of pinion and $O S$ to that of the wheel; the same lettering being used and the same wording applying, with the exception that instead of the words "the rectangle $O F E S$ is completed," we should substitute the words "the parallelogram $O F E S$ is completed," and $F G$ now being of a different length, the number of teeth will no longer be 18. In the case chosen, where the axes are inclined at an angle of 100 degrees, the numbers of teeth would work out to 16 and 40, as best satisfying the given conditions.

Returning to the main problem, we have now determined the number of the teeth of pinion and wheel, and it remains to readjust the diameters and the angle of inclination of the teeth, so as to comply with the conditions laid down as to the pitch, the centers of the wheels and the number of teeth just found. Referring to Fig. 3, it is evident that the effect of choosing the number of teeth for the wheel and pinion, respectively, has been to slightly alter the length of the line $G F$, and consequently to slightly change the value of the angle α. If $O K$ be drawn equal to the provisional diameter of the wheel, and $K H$ perpendicular to the slightly altered line $O E$, it is evidently possible to find such a position of $O E$ and such values of the diameters as will satisfy the conditions as to the number of teeth and the wheel centers. The data at hand are, that we know the correct length of $F G$ to be the number of teeth in the pinion multiplied by the diametral pitch, and the length of $H K$ to be equal to the number of teeth in wheel multiplied by the diametral pitch; the sum

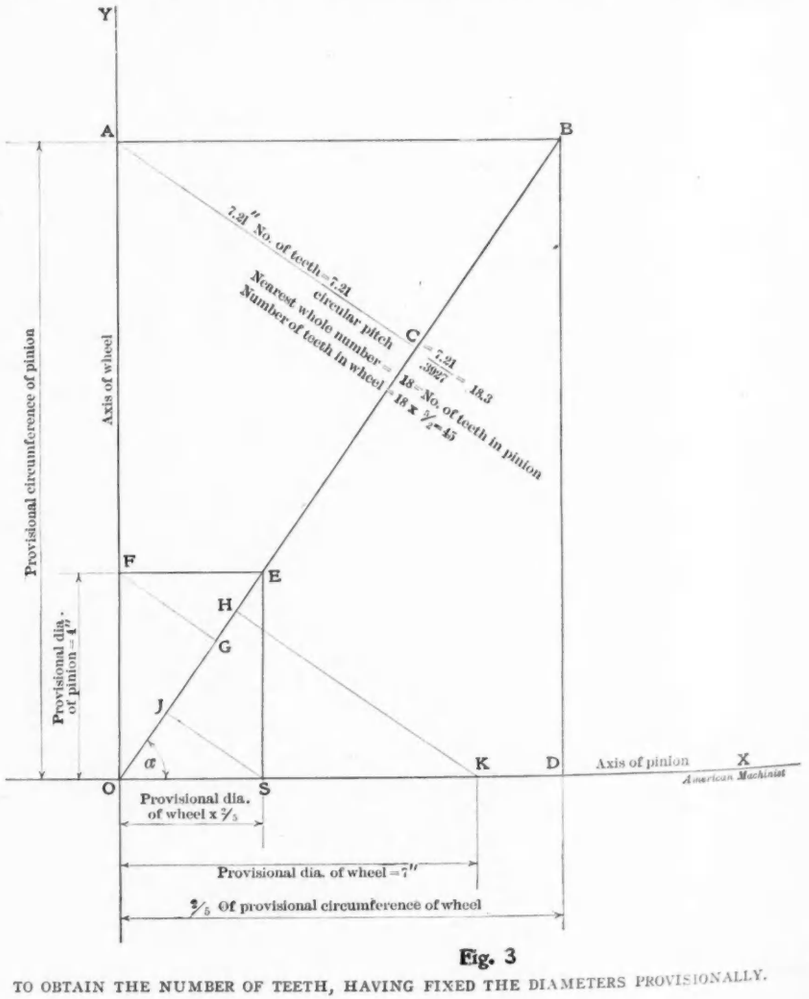


Fig. 3

TO OBTAIN THE NUMBER OF TEETH, HAVING FIXED THE DIAMETERS PROVISIONALLY.

of the diameters is also given us, and we know that the sum of the angles $E\,O\,S$, $E\,O\,F$ is a right angle. Turning to Fig. 4, $X\,O\,X'$ and $Y\,O\,Y'$ are drawn at right angles, and $O\,B$ is laid off along $O\,X$ equal to $18 \times \frac{1}{8}$ inch (*i. e.*, the number of teeth in the pinion multiplied by the diametral pitch), and $O\,F$ along $O\,Y'$ equal to $45 \times \frac{1}{8}$ inch (*i. e.*, the number of teeth in wheel multiplied by the diametral pitch), and $A\,B$ and $E\,F$ are drawn parallel to $O\,Y$ and $O\,X$. To complete the construction, it is only necessary to find a line drawn through O and terminating in the lines $E\,F$ and $A\,B$, such that the intercept between these lines is 11 inches long (*i. e.*, equal to twice the wheel centers or to the sum of the diameters of wheel and pinion). The line $A\,E$ fulfills this condition, and is easily found, as follows: A scale or straightedge should be placed so that the graduated edge lies on the point O and the commencement of the scale points directly over the line $E\,F$. The scale should then be moved by rotating its edge about O and at the same time moving it longitudinally, so that the zero graduation always lies over the line $F\,E$, until a position is found in which the graduation marking 11 inches lies directly over the line $A\,B$. When this position has been found, the line $E\,F$ should be ruled in. The lines $X'\,Y'$ and $D\,A\,R$ should be drawn through E and A at right angles to $E\,A$ so as to cut the lines $X\,O\,X'$ and $Y\,O\,Y'$. Then the line $E\,O$ gives the length of the diameter of the wheel and $O\,A$ the diameter of the pinion; $X'\,E \times 3.1416$ gives the spiral pitch of the wheel, and $A\,D \times 3.1416$ gives the spiral pitch of the pinion. Moreover, in selecting the cutters, it is necessary to select them as if for a spur wheel containing a greater number of teeth than the actual number in the gear to be cut, owing to the difference of curvature at a point on the circumference of the pitch surface of sections along the normal helix and along a circumferential line.

The number of teeth in a spur wheel for which the cutters should be selected is given, in the case of the pinion, by dividing $O\,R$ by the diametral pitch, and in the case of the wheel by dividing the line $Y'\,O$ by the same amount. Thus the wheel should be cut by a cutter which would be used for cutting the teeth of a spur wheel of N teeth, where $N = 45 \times Y'\,O \div F\,O$; while the pinion would be properly cut if the cutter were chosen as if for a spur wheel having a number of teeth equal to $18 \times R\,O \div O\,B$—that is to say, equal to the number found by dividing $O\,B$ by the diametral pitch. The reader who wishes to verify these relationships may do so by turning to Fig. 3. For supposing that $F\,G$ and $H\,K$ in that figure had been integral multiples of the normal pitch, $F\,O$ and $O\,K$ would have given correctly the diameters to comply with the other conditions, and on comparing the triangles $A\,O\,B$ in Fig. 4 with $F\,O\,G$ in Fig. 3, and $O\,E\,F$ in Fig. 4 with $K\,O\,H$ in Fig. 3, it will be found that Fig. 4 is merely a rearrangement of Fig. 3 for the purpose of convenience, and that the sides $O\,K$ and $O\,E$ correspond, as do also the sides $H\,K$ and $O\,F$. The relationship giving the spiral pitch follows from the definition of that term. For example, in Fig. 4, ϕ is the angle between the helical intersection of the tooth face of the wheel with the pitch surface, and $E\,F$ is the diameter; consequently, $X'\,E$ is equal to the spiral pitch divided by 3.1416.

The statement as to the proper selection of cutters may be explained if it be remembered that the average curvature in the direction of the normal helix is the governing factor in settling what cutter should be used, and since the length of one convolution of the normal helix bears to the diameter of the pinion the ratio $O\,R$ to $O\,A$ (see Fig. 4), the number of times that the normal pitch is contained in $O\,R$ gives the number of teeth in a spur wheel having the same curvature as the normal helix. In applying the construction of Fig. 4 to the case when the axes are not at right angles, it is necessary to draw $O\,Y'$ along the axis of the wheel and $X\,O$ along the axis of the pinion, and at the same angle as the acute angle included by the axes. The construction is given for a particular case in Fig. 6, and the reader should find no difficulty in applying it to any special case.

It is convenient to have all the formulas required for a special purpose grouped

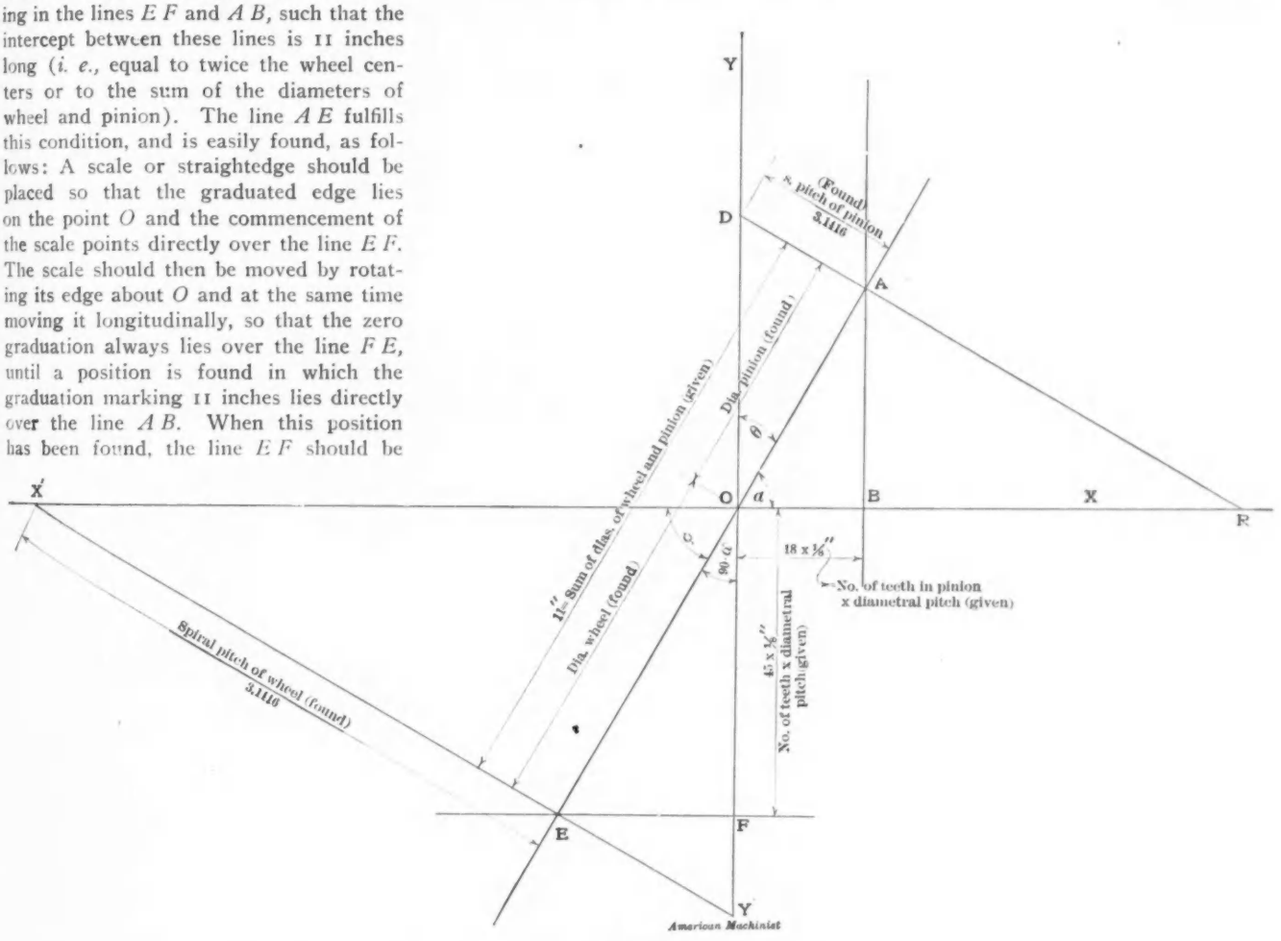


Fig. 4

GIVEN THE PITCH, NUMBERS OF TEETH AND WHEEL CENTERS, TO FIND BY CONSTRUCTION THE ANGLE OF TEETH, THE CORRECT DIAMETERS OF WHEELS AND THE SPIRAL PITCHES.

together for ready reference. I have compiled, therefore, the following reminder on spiral gears.

NOTE ON SPIRAL WHEELS.

c = distance between the axes of spiral gears.
d = diameter pinion.
D = diameter wheel.
r = revolutions of pinion for one revolution of wheel.
n = teeth in pinion.
$N = r\,n$ = teeth in wheel.
s = spiral pitch for pinion.
S = spiral pitch for wheel.
α = angle between tooth face of pinion and axis of pinion.
ϕ = angle between tooth face of wheel and axis of wheel.
β = obtuse angle between the axes.
n_c = number of teeth in a spur wheel, the cutter for which should be used for pinion.

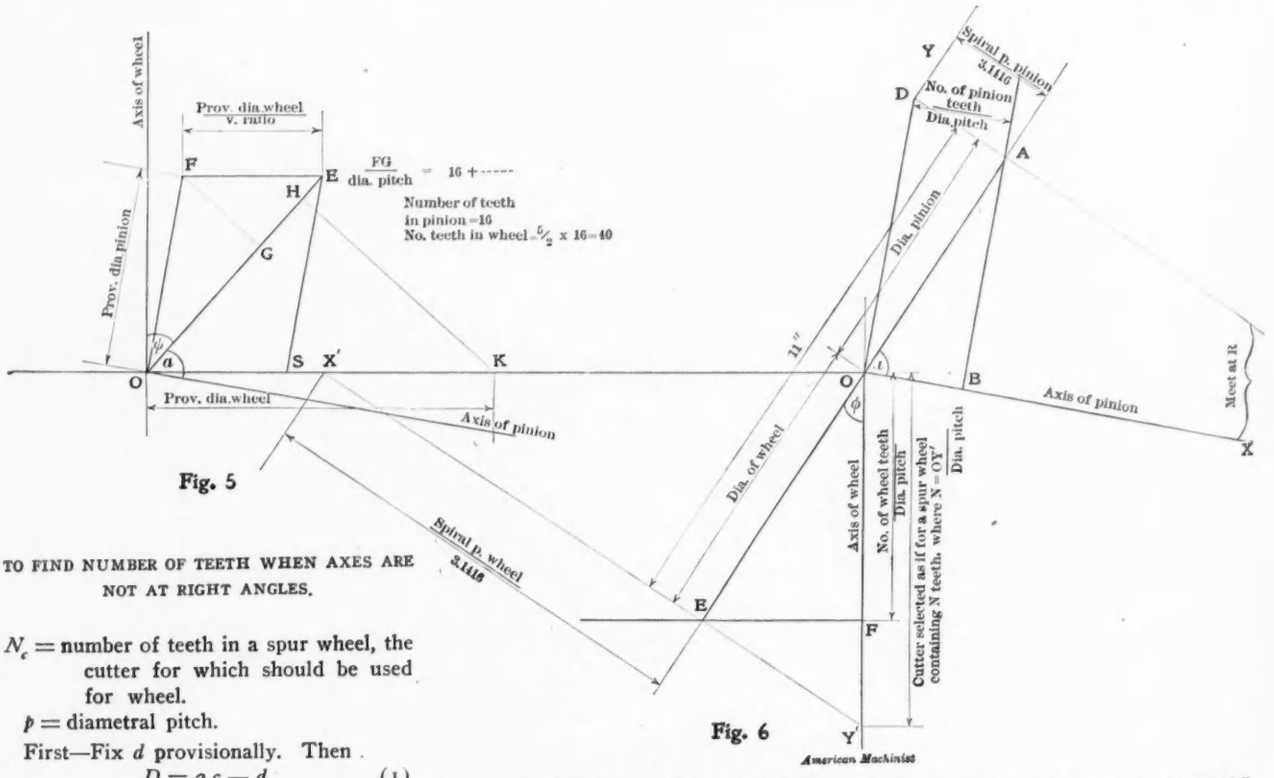


Fig. 5

Fig. 6

TO FIND NUMBER OF TEETH WHEN AXES ARE NOT AT RIGHT ANGLES.

GIVEN THE NUMBER OF TEETH, TO FIND DIAMETERS, SPIRAL PITCHES AND ANGLES BETWEEN TEETH AND AXES OF WHEELS.

N_c = number of teeth in a spur wheel, the cutter for which should be used for wheel.
p = diametral pitch.

First—Fix d provisionally. Then

$$D = 2c - d. \qquad (1)$$

Find α from $\cot.\alpha = \frac{D}{r\,d}\operatorname{cosec}.\beta - \cot.\beta$ (2)

and n = nearest suitable whole number to

$$\frac{d\cos.\alpha}{p} \qquad (3)$$

and $$N = n\,r.$$

Secondly—Retain these values of N and n and recalculate d, D, α, etc.

Find α from $\frac{n}{p}\sec.\alpha + \frac{N}{p}\sec.(\beta-\alpha) = 2c$ (4)

$$d = \frac{n}{p}\sec.\alpha \quad D = \frac{N}{p}\sec.\phi = \frac{N}{p}\sec.(\beta-\alpha) \qquad (5)$$

$$s = d\cot.\alpha \quad S = D\cot.\phi \qquad (6)$$

$$n_c = n\sec.^2\alpha \quad N_c = N\sec.^2\phi \qquad (7)$$

Third—If $\beta = 90$, as usually happens, (2) becomes $\cot.\alpha = \frac{D}{r\,d}$

(3) becomes n = nearest integer to

$$\frac{D\,d}{\sqrt{r^2\,d^2 + D^2}}$$

and

(4) becomes $\frac{n}{p}\sec.\alpha + \frac{r\,n}{p}\operatorname{cosec}.\alpha = 2c.$

New Brompton, England.

Legal Notes—Employer's Knowledge of Defect in Machinery—Failure to Warn Inexperienced Workman.

BY W. M. SEABURY.

A man named Chalkley, employed by the Virginia and North Carolina Wheel Company, was injured while operating a circular saw used in the manufacture of wagon spokes. Chalkley sued the company to recover damages for his injuries and was awarded a verdict by the jury in the trial court.

The defendant appealed to the Supreme Court of Appeals of Virginia upon the ground that the instructions given the jury were improper. The trial judge had instructed the jury that if they believed that the plaintiff's injury was caused by defects in the machinery and appliances about which he was engaged in working then he was entitled to recover, unless he knew, or by the exercise of reasonable care might have known, of such defects, and of the danger in working with the machines in their condition, or unless he was guilty of contributory negligence, without informing the jury that they must further believe in order that the plaintiff should recover, that the wheel company knew or ought to have known of the defects which caused the injury.

The Appellate Court held that for the failure of the trial judge to make the proper instruction the judgment should be reversed and a new trial had.

In rendering the opinion the court said: "While it is clearly the duty of the master to exercise ordinary care to provide for the use of his servants reasonably safe, sound and suitable machinery and appliances, and to examine and inspect such machinery and appliances from time to time, and to use ordinary care to discover and repair defects in the same, still unless he knows, or would have known if he had used ordinary care, that the machinery or appliances which he has provided for the use of his servants have become defective and unsafe, he is not liable for injuries resulting therefrom." (34 S. E. R., 976.)

FAILURE TO WARN INEXPERIENCED WORKMAN.

The suit brought by B. F. Robertson against the San Antonio Gas Company has recently been decided by the Civil Court of Appeals of Texas in favor of the plaintiff, Robertson.

Robertson was in the employ of the defendant gas company, and while he was applying some hot coal tar to a hot boiler, as directed by the defendant, the tar exploded, and some of it flying into his eye caused him such injury that he lost his eye.

To recover damages for this injury he brought suit, upon the ground that the defendant knew the danger of tar exploding, but had failed to give him, an inexperienced workman, any warning of the danger.

In the trial court the plaintiff received a verdict and judgment for $2,200, which judgment the defendant endeavored to set aside on appeal.

A slight error in the charge of the judge was the basis of the appeal, but the Appellate Court affirmed the judgment and held that it is not the rule in Appellate Courts to reverse cases, even when there is positive error in the charge, unless it is reasonably apparent that the jury may have been misled by it. (55 S. W. R., 347.)

The Breaking of a Large Casting.

The half-tone tells its own story. It shows simply the parts of a broken cylinder of a hydraulic press, broken not in the course of legitimate work, but by an abnormal and uncontemplated pressure

A BROKEN CASTING.

due to an improper manipulation of the controlling valves. Although the area of the fracture is so large it is evident that here, under the circumstances, was the weakest spot of the combination. The press was in the factory of F. N. Du Bois, of this city, and was used in the manufacture of lead pipe. It had been in constant use for three or four years. The casting was made of the well-known gun iron of the West Point Foundry, Cold Spring, N. Y. The internal diameter of the cylinder is 16 inches, with 8½ inches of metal around it, so that the area of the fracture is considerably over 600 square inches. As the total working load did not exceed 600 tons, this would have been less than one ton per square inch of section. The strain over the surface of fracture

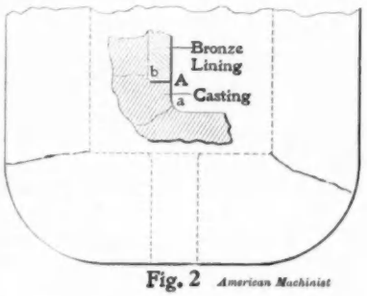


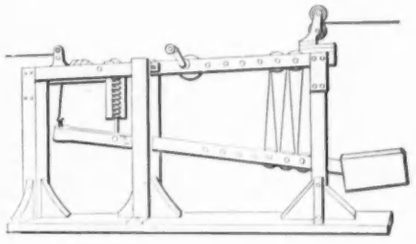
Fig. 2 *American Machinist*

could, however, never have been equally distributed, and in fact the periphery may have had very little opportunity to exercise any effective resistance until the fracture began, and it certainly was not effective then. The sketch, Fig. 2, gives an idea of the general direction of the fracture, there being considerably more obliquity on one side than on the other. At *A* is a sketch to a larger scale, which gives a better idea of the corner where the fracture occurred. It was actually at *a*, all around the cylinder, although anyone would naturally ask why it did not begin at *b*, where the metal was thinner. In the casting, and also in the boring, sharp corners were carefully avoided, and the fracture shows clean, solid metal, without a flaw.

Indicator Reducing Movement of Wide Adjustment.

A reducing mechanism for indicator practice, which can be constructed at little expense, has been devised by Harrison Barnwell and is illustrated in the "Revue Industrielle," Paris. The inventor was led to its use by having occasion to take cards from a large number of engines and steam pumps with strokes varying from 5 inches to 10 feet and running at greatly different speeds, although it would seem to be inapplicable to great rotative speeds, since its operation depends, in part, upon the effect of a weight which rises and falls with each revolution.

Upon a board for a base are placed three uprights. In an open space in two of them a lever made of two light, flat bars of iron turns on an axis supported by a fulcrum rod extending downward from the beam connecting the tops of the uprights. To the end of the short arm of this lever is attached a cord which passes over a pulley, thus allowing it freely to take different angles. The cord is connected with the indicator. The long arm of the lever carries seven grooved pulleys and at the end a weight of lead. The beam that joins the tops of the uprights carries a row of six grooved pulleys and a little drum provided with a crank, rachet and pawl. A second cord, one end of which is fast to the drum, passes alter-



nately a greater or less number of pulleys on the lever and beam, according to the reduction of motion required, then over a pulley attached to the beam, which permits the cord to take the direction of that part of the engine to which it is to be attached. By winding the cord more or less on the drum with the crank, the movement of the lever is adjusted so that it oscillates equally above and below the horizontal.

To set up the apparatus it is sufficient to place it upon the floor and fasten it down with screws, or even to hold it merely by weighting it; then to attach the cords to engine and indicator and make the requisite adjustments.

The Rochester Mechanics' Institute, Rochester, N. Y., has received from Mr. George Eastman, inventor and promoter of the Kodak camera, an unconditional gift of $200,000. The money will be used for enlarging the present building.

Letters from Practical Men

The Employment of Skilled Labor.

Editor American Machinist:

Did you ever think that when a foreman is put in charge of half a hundred tool makers he has confided to his care fifty of the highest priced and most sensitive tools that were ever put into a shop—mechanism that costs the company an average of a thousand dollars a year to maintain, and that should be handled with diplomacy to produce the best possible results with the least friction? For of all frictions I know of none is so expensive and difficult to lubricate as that between a tool maker and his foreman. It may not squeak as loud as a loose pulley that needs oiling, but it is there just the same.

Now, if that foreman wanted to put in six more machines the interest on the investment for which would amount to $6,000 a year, what a howl would go up at the next directors' meeting! And if in addition to that he should take the first six that he came across, without so close an examination as he would give a 6-inch scale he was intending to purchase, he would be considered a fit candidate for a lunatic asylum; but I have often seen six tool makers put in with even less inspection. It is true you cannot always inspect the tool makers with the same degree of discernment that you give the 6-inch scale, but a few well-chosen words will often give you a good insight into a man's abilities, or, at least, into what he thinks are his abilities.

I once worked in the office of a very busy superintendent who did the hiring and sacking for the whole shop. He had three questions he used to ask each man: "Where did you work last?" "How long were you there?" "What wages did you receive?" Then he would form his conclusions from the answers he received, and he used to get very near the truth.

A marked contrast to this superintendent was one I had the pleasure (?) of being engaged by some years before. I arrived at his office, by appointment, at 7:45; he came in at 8 o'clock, and we talked until 1 P. M. I went out to lunch, and then returned to the factory, and that man kept me until 5:30 that night before a decision was reached, and I let him do all of the talking, too.

Your esteemed correspondent, Mr. Tecumseh Swift, brings out a good idea (in fact he brings out a good many of them) when he suggests that a man be requested, when he leaves the employ of the company, to give his reasons for so doing. I have followed this plan with the better grade of workmen for a number of years, and in looking over the replies I find that nine-tenths of them read: "Better employment elsewhere;" a few are "dissatisfied with the work;" and one is "shop is too dirty." The last remark came from one of those men who could not bear to soil his hands, and should never have been a machinist anyway.

One great thing which promotes good feeling between a foreman and his men is: Never ask a man to do anything that you would not do yourself if you were in his place, and never give an order in a manner that indicates that you wish to "show your authority," for, as one of the most successful superintendents I ever met said to me once, "a pat on the back will often do more good than a kick applied elsewhere." I must admit that this does not always apply to the cheaper grades of labor, for there are men who admire a boss who can keep the air blue around them most of the time, and when I find a man of that sort I give him a chance to go and find a foreman that is better suited to his taste.

Another thing that I think has a good influence in handling labor of this kind is personal respect. If you meet one of your men at a social gathering, at the theatre, or at church, treat him as an equal; don't think because you are his foreman you can have all the cream, even if you don't pay any more than he does, or perhaps not so much. These ideas may be democratic; I don't know whether they are or not; but I do know that they will go a long way toward preventing the friction that doesn't squeak.

Now, about discharging: When a man "jacks up his job," as the boys call it, don't give him a call-down if he is a good man; tell him you are sorry to have him go, and when he gets homesick and wishes to come back, to come around and see you, and if there is a chance he shall have it, and he will come, too.

A. P. Press.

A Novel Drill Jig.

Editor American Machinist:

The work to be drilled by the jig here shown was a piece of steel 1⅞ inches long, with a ⅞-inch reamed hole through the center, and there were sixteen holes, 22 drill-gage, to be drilled, as shown in Fig. 3; that is, entirely around on a ¾-inch pitch helix. Then there were three holes from *A* to *B*, Fig. 2, so that when these were separated, as shown in Fig. 1, and finished on a milling rig, which I will explain later, they would form two perfectly fitting cams, which, in a friction clutch that we were making, would open and close by the aid of two fingers, not shown. Fig. 4 shows the jig complete. I wish to state that we were using the cams in large numbers.

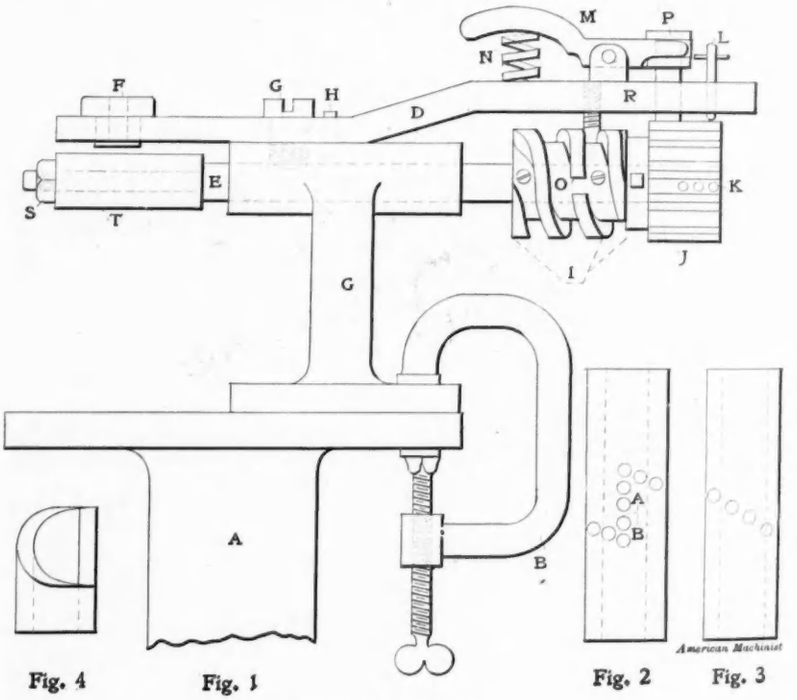


Fig. 4 Fig. 1 Fig. 2 Fig. 3

A NOVEL DRILL JIG.

A is the table of the drill press, *B* a clamp, showing how it was secured to the table; *C* is the body, which was of cast iron planed on the bottom, with a hole through it for the shaft *E*; *D* a piece of flat machinery steel, 1¼ inches wide by ⅜ inch thick, bent in the way shown and fastened to the body by two screws at *G* and dowel pins *H*. The index plate *J* was a piece of machinery steel 2½ inches in diameter, with sixteen grooves milled in it to admit the lock pin *P*, and to evenly space the holes. The worm *I* was of iron, cut on a ¾-inch pitch with a cross groove at *O*. The pin *R* was driven into *D* and fitted smoothly the worm, as shown. *M* was the lever for raising the lock pin, and *N* the spring to keep it in the groove in the index plate. *T* was the piece to be drilled, the shaft *E* being turned to fit the ⅞-inch reamed hole and the thread cut on the end for the nut *S* to keep the

work in place for the drilling. *F* was the bushing to fit No. 22 drill. The index plate was turned one space at a time and the pin *R* would, in the course of sixteen spaces, cause the work *I* to make one complete turn on the ¾-inch pitch, when the pin *L* would be in line with the first of the three holes *K*, and the pin *R* in line with the slot in the worm at *O*. The pin *L* was then entered into the first hole, then the next by pulling the shaft out, and then the last, when the pin *R* would be in the next thread of the worm, and, the work being completed, removed, when it could be easily broken apart, the holes having all but run into each other. The worm and index plate were secured by set screws, as show.

We made four different sizes of cams, ¾-inch, ⅞-inch, 1⅛-inch and 1¼-inch, respectively, and all that was necessary to alter the jigs was to take off the worm and index plate and replace with other sizes.

JOSEPH V. WOODWORTH.

Brooklyn, N. Y.

Machine Shop Belts.

Editor American Machinist:

There is, perhaps, no single feature of a machine shop which to the casual visitor so plainly indicates the character of the management as do the belts which drive the machines. No one who allows things to drift along easy ever bothers much about them, but unless they receive considerable care and attention it is hardly possible to secure the maximum output. Machine tools, particularly if a little out of date, generally have pulleys so small and narrow that the capacity of the machine is limited by the condition of the driving belts. About the first move to be made in trying to increase the output of the shop is to make sure that each tool has all the power it can safely use. A poor quality of belt is wasteful in every way; the very best is cheapest for machine shop service.

Except for the lightest work, single belts are of little use; cone belts can usually be double thickness when over 2 inches, and triple when 4 inches or wider. Besides doing so much more work than thinner belts, they last enough longer to make them really cheaper in cost. On cone pulleys no belt should be used that is not at least ½ inch narrower than the step of the cone. As tool builders generally make the pulleys only about ¼ inch wider than the belt figured to be used, and as widths of belt readily obtainable go by halves of an inch, this rule usually results in a belt ½ inch narrower than the one the makers intended and ¾ inch less than the cone steps. This is all right, though it must be confessed it looks queer to advocate the use of all the belt power obtainable and then in the next sentence to advise narrowing of the belts ½ inch. The fact is, that on a cone pulley of, say, 4¼-inch face a 3½-inch belt will do more hard work and last longer than a 4-inch belt—particularly when both are double. When a belt does hard work it will not run within ⅛ inch of true each way very long. If the 4-inch belt goes out of true more than that it rubs the edge of the next step of the cone, and its ruin begins. Every lathe man knows what happens when the belt crowds against the cone; the edge of the belt is softened up and its fibres loosened so that the strip affected is destroyed, so far as doing any good is concerned. The reason the belt runs out of true in the first place is because one edge stretches more than the other, the chafing stretches that edge still more, and the belt in consequence crowds harder and is chafed more, until finally it flops clear over and runs with a twist in it. It is ruined then and should be taken off. There are at least two ways to prevent this. One, which is practiced very extensively and successfully, is to use great care never to overload the belt—take light cuts and keep the belt so loose that it cannot by any possibility pull enough to injure it. Another method is, as outlined, to use the very best belting obtainable, in double or triple thickness, and something like ¾ inch narrower than the step of the cone In addition, speed up the countershaft to the highest speed permissible; that is so the largest piece likely to be turned will not run too fast. Thirty feet per minute is a moderate speed for cast iron, using self-hardening steel for tools, and figuring on that basis it will be found that on most lathes—of the kind that lack power—the countershaft can be speeded up considerably. Of course, this makes it easier on the belt, even though the lathe spindle runs at the same speed, for the belt is shifted to a larger cone step and runs faster. The narrow, thick belt is nice to handle, keeps its shape, and with decent care will last a long time and do a lot of hard work.

It is an old trick to throw off cone belts every night, or at least on Saturday nights, and let them shrink up. There is really something in it; the belts certainly recover some of their elasticity and run better, besides not requiring to be taken up as frequently. Regarding the speeding up of the countershafts, it often pays to put another pulley on and give the countershaft two speeds—one, say, twice as fast as the other. Sometimes the backing motion is not needed, and the pulley can be utilized for this purpose. In addition to giving more power at the same spindle speed, this arrangement makes a very convenient way of changing the speed quickly, simply throwing the shifter over. In many lathe operations this saves a good deal of time. If lathe makers would leave off some of the elaborate devices for rapid changes in screw cutting, and, taking a cue from the turret lathe makers, supply means of changing speeds quickly, their lathes would be capable of doing more work.

Planers can generally have two speeds to good purpose—making the faster one 25 to 30 feet per minute on the cut, and the slower 18 to 20 feet for steel or specially hard castings. There is no other way in which the capacity of the average machine shop may be so easily and cheaply increased as by arranging the belts and pulleys to supply sufficient power to the machines. Of course, putting the belts in shape is not all there is of working machines up to capacity, but it is the first move to make. It is really very discouraging to the machinist to try to crowd the average tool to something near what it ought to do. Put things in shape for him and he will meet you more than half way. If he doesn't it is the fault of his training. Don't be cross if he breaks something by crowding the work, but make it strong enough so it won't break at that place again. Then the machine will do more work than it would before. An engineer who was, when living, one of the brightest men who ever ran a machine shop, used to say to his men: "If you can break that tool by putting on a cut, you smash it all to smithereens." E. J. ARMSTRONG.

A Boiler Draft Puzzle.

Editor American Machinist:

I put a stack and breeching on four boilers, as shown in the rough sketch. All have a splendid draft, except No. 1. Nos. 2, 3 and 4 will all draw at once or singly, and No. 1 will not draw either alone or with the rest. The setting of each is identical; Nos. 1, 3 and 4 are each 54 inches by 16 feet; all have 4-inch tubes and are alike; No. 2 is 64 inches. The stack is 48 inches by 80 feet.

I have seen cases where the direction of the wind had an effect upon the draft; perhaps the barometric pressure changed with the wind. The No. 1 is the one on the southern end of the row, and the wind is nearly always in the southeast or from the Gulf. I thought that a diaphragm or plate in the breeching would improve it (see sketch at *A*); but even if it did, it will not explain why No. 1 does not draw. The breeching is not of a very neat design. The ends over Nos. 1 and 4 look clumsy. If it was so over No. 1 alone, I would think it had some effect on the draft; but as it is the same over No. 4, that draws as well as Nos. 2 or 3, it cannot make any difference. As it is, No. 1 is utterly useless and cannot be used at all. If you can tell me where the trouble lies, or suggest an improvement, it will be appreciated. The stack is not exactly over No. 2. No. 1 is farther from the stack than No. 3 by about a foot; it was set before it was connected with Nos. 3 and 4 to the same stack, and did not draw. Then it had a separate stack and did draw. Then No. 2 was added, and all connected to the stack. They are all 16 feet long; all have splendid draft, except No. 1. Today I saw two 100 horse-power boilers

connected to a 60-inch by 120-foot stack, all new, that would not supply steam for a 50 horse-power Corliss engine; but I think I could find the trouble in that job in a patent air heater. HARRY GUNTHER.

San Antonio, Texas.

Purdue University Steaming and Gluing Apparatus.

Editor American Machinist:

One of the sources of annoyance to the wood worker, and especially to the pattern maker, is usually in the arrangements for gluing and bending. Generally a rudely improvised steaming tank and a glue pot which is more of an aggravation than anything else are all that is provided. The pot seldom gets cleaned, and when it does the dried glue must be cut off in chunks, while the most natural way would be to boil it off in a tank. When the cleaning is done by boiling it is necessary to have several pots, so that when some are withdrawn for cleaning there are fresh ones to take their places.

Too much care cannot be exercised in keeping the gluing apparatus clean, for if neglected it becomes very unsightly. Glue should not be hurriedly prepared. It should be well broken up, covered with cold water and allowed to stand until thoroughly soaked. Heat must then be applied slowly until all is dissolved. It is well to have one pot of glue somewhat thinner than the rest for sizing purposes.

An apparatus to fill the above conditions, and one which would be very convenient in any shop, I designed and constructed in the Purdue University laboratory, and it is now in use by the students in pattern making. The number of men to be accommodated during each working period is, at present, about eighty. The demand upon such an appliance in an engineering school is much greater than in the average pattern shop, and everything must be made as nearly automatic as possible. In this case there are two tanks, each carrying two glue pots and each tank having its own steam supply. The steaming box is arranged to have a good circulation of steam at atmospheric pressure. This is a convenient place in which to keep fillets steaming for use on pattern curves.

Fig. 2 shows a section through the steaming box and glue tank, but does not show the boiling tank below, in which the pots are cleaned. The overflow from the glue tank is carried into the steaming box, and the steam is kept from returning up this overflow pipe by a trap *A*. Live steam enters the box at *B* and leaves through the drain pipe. The doors *C* are machine fitted and only require a slight turn of the hand wheels *D* to bring them up snug enough to keep from leaking steam. The overflow pipe from the glue tank is screwed tightly into the tank bottom and slips loosely into the goose-neck. A false cover *E* is fitted in each tank and rests on a small ledge above the water line and keeps the boiling water from running over the sides. Fig. 1 is a front elevation and shows the relative positions of steam pipes and tanks.

Figs. 3 and 4 show front and rear views respectively. The entire apparatus is made of iron, the upper surface being planed and beeswax melted into it. This gives a glossy surface, and the glue peels off when drying, thus rendering the cleaning comparatively easy. J. D. HOFFMAN.

La Fayette, Ind.

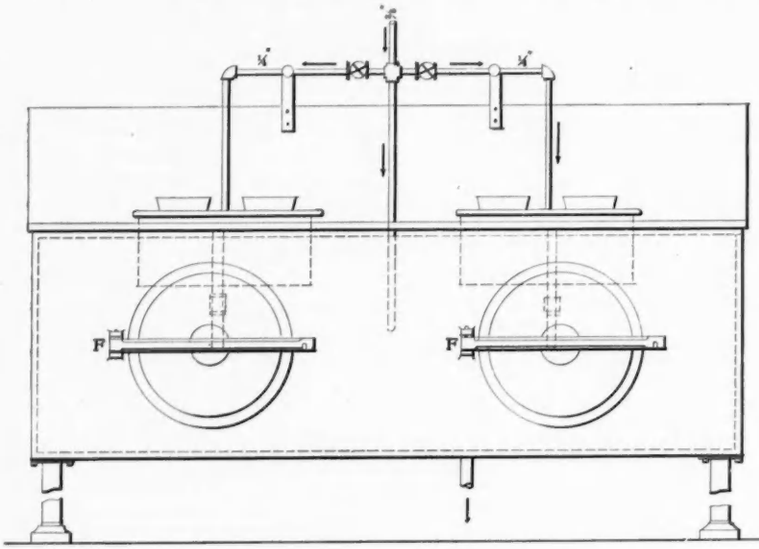


Fig. 1

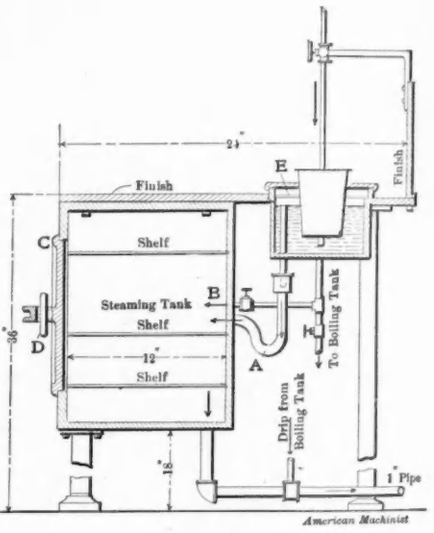


Fig. 2

PURDUE UNIVERSITY GLUING AND STEAMING APPARATUS.

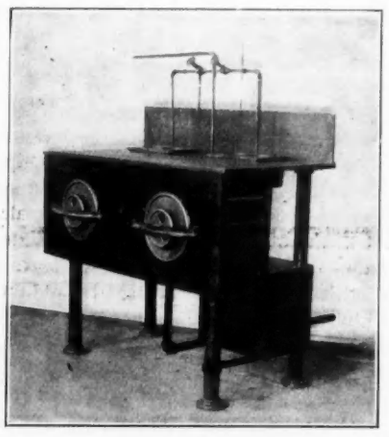


FIG. 3. FRONT OF GLUING APPARATUS.

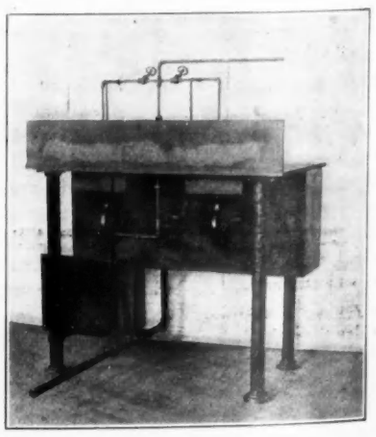


FIG. 4. BACK OF GLUING APPARATUS.

Saw-Tooth Roof for a Foundry.

Editor American Machinist:

Some time ago we wrote you inquiring if you knew of any foundries having saw-tooth roofs, and after careful inquiry you were unable to learn of any. Since then we have put up a temporary foundry, and it is built with a saw-tooth roof. It is 162x45 feet, 12 feet high at the eaves and 18 feet at the gables, with the roof in two sections and a row of posts down the middle. The light is very good, but the ven-

tilation is not so good as it might be, on account of the very low roof.

The hight should be not less than 20 feet at the eaves and 30 feet at the gables. We used tar and crushed limestone for the roof, using no flashing in the gutters, and have had no trouble from leakage or snow. The roof is 18 inches lower at the west end than at the east end, which gives good drainage to the gutters. Have had some trouble from sweating, but this could be avoided in a permanent building.

We placed the roof windows vertically instead of inclined, which seems to be the common practice. We believe this to be practically as good and much cheaper. Sketch shows general construction of building, which has answered its purpose very well and was very cheaply built. All factory buildings which we may have occasion to build from now on will have saw-tooth roofs. WILSON P. HUNT.

Moline, Ill.

A Drill Jig for Bevel Gears.

Editor American Machinist:

The average machinist, being familiar with the difficulties usually attending the chucking of rough-cast gears in an ordinary lathe chuck, may perhaps be started on the way to improved methods by the accompanying sketch and description.

A is the base of the chuck, threaded on the outside of its largest diameter and bored to receive ring *B*. The base *A* is provided with hub *K*, intended to fit in the hole of the drill press table *centrally*, its center at *J* being bored large enough to clear the largest hole to be bored. It is further provided with detent *M* to prevent its turning while chucking or boring. *C* is a case, or cap, threaded internally to fit *A*, and may be screwed on when gear *E*, to be bored, is in position, as shown. It will be seen that by screwing down case *C* until it presses on the back of gear 3-3 it will hold the gear in the centering ring *B*, seating the teeth at 4-4. Case *C* is provided with a plate *D*, mounted on stud *F*. This plate carries a number of thimbles, and when either is brought to the central position the plate is held by taper pin *H*. Any number of rings may be made to suit gears to be bored, all fitting plate *A*.

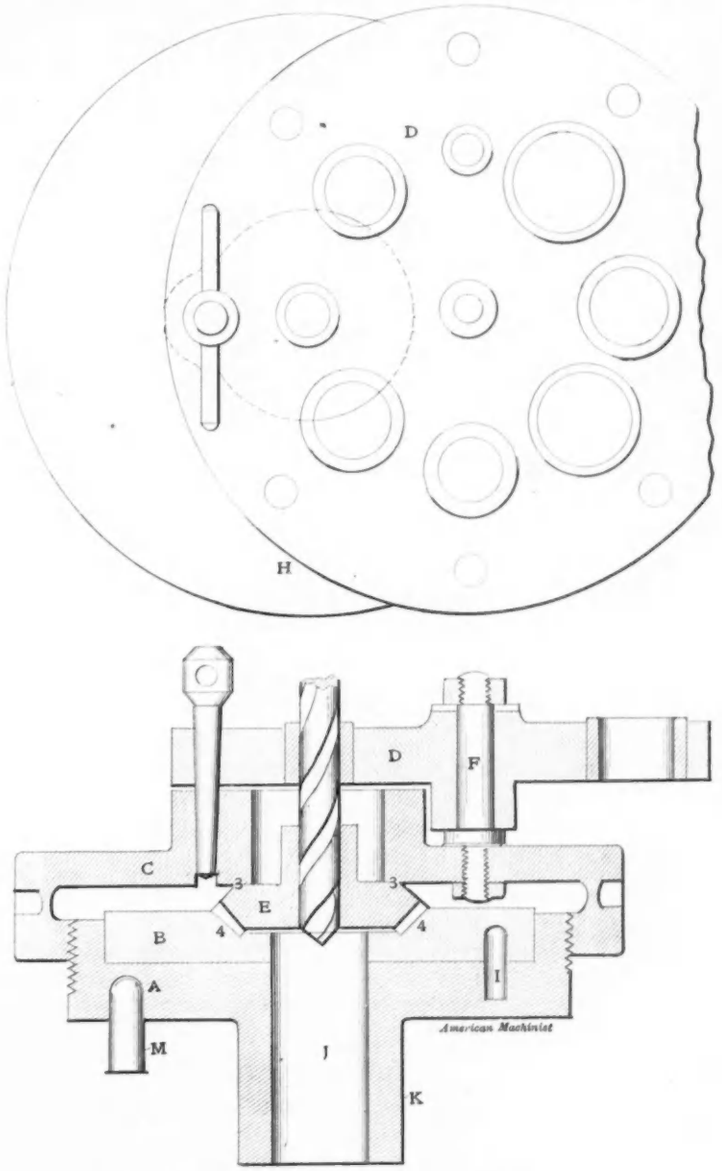
The plan shows the jig with eight thimbles, either of which may be brought into proper position instantly. It will be understood that all thimbles or bushes should be bored true, lapped to fit rose reamers and hardened. *I* is a detent pin fitting loosely into plate *A* to prevent ring *B* from turning. The screw case *C* has a number of holes for spanner wrench. Of course, it will be understood that this jig may also be used on a lathe having a turret head to much better advantage than on a drill press. When there are no turret lathes available the drill press will answer the purpose. PETER SCHELLENBACH.

Anderson, Ind.

Unground Steam Joints.

Editor American Machinist:

In answer to Mr. Newton's inquiry in your issue No. 13, regarding the width of seat required for unground joints, would say that my usual practice has been to make them from about 3/8 inch down to 3-16 inch. There is no difficulty in making them wider than this if the parts are sufficiently stiff and the bolts are large and plentiful enough, but there is no good reason for making them wider, and the narrow seat is surer and gives less trouble. If they leak, by reason of lack of stiffness of the parts, by the bolts being far apart, or by imperfect workmanship, our remedy is to make the seat narrower. This is as true of ground as of unground joints; they are usually made much too wide for the best results. Cast iron is very elastic—how much so those who handle it most seldom realize. In the joint of, say, a steam chest cover, with bolts several inches apart, a strain on the bolts just equal to the pressure of the steam on the inside of the cover, the joint will not be tight. It may not leak close to the bolt, but it will midway between them. The cover distorts under pressure—a small amount, it is true—but enough to permit steam to pass. To make it tight, the joint must be held together closely, and to do this midway between the bolts requires that the portion of the seat close to the bolts must be more than in contact, must be under pressure sufficient to actually compress the metal, and so distort the cover between the bolts at least as much as the steam pressure would. The amount of this compression of the metal is obviously a question of pressure per square inch of surface of the seat, and it is plain that the narrower the seat the more pressure per unit of area may be put on it with the same bolts. The machined surfaces require rather more pressure per square inch



CHUCK AND DRILL GUIDE FOR CAST BEVEL GEARS.

than the ground seats—probably by reason of greater inaccuracy—and hence need to be somewhat narrower.

Mr. Newton questions my notion that meritorious shop kinks seldom come into general use by being published. As this particular kink is certainly a good one, it is perhaps permissible to refer to an article by Prof. John E. Sweet on "Steam Joints Without Grinding" ("American Machinist," September 17, 1887), and ask how many engine builders have profited by it?

E. J. ARMSTRONG.

Drawing Dies for Large Pans.

Editor American Machinist:

The enclosed sketches show punches and dies for drawing a tin pan, 8 inches diameter and 3¼ inches deep, from stock .020 inch thick, in which the features of the inside blank-holder for this kind of work are exemplified. The method of drawing and redrawing sheet metal by which deep cylindrical pans of a large diameter are made from a flat disk, differs in some respects from the ordinary way usually employed for drawing cups of a small diam-

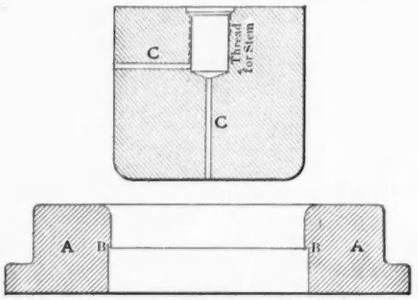


Fig. 1

PUNCH DIE AND BLANK HOLDER FOR REDRAWING.

eter. The redrawing operation for large work, especially when thin metal is used, as the wrinkles have a tendency to develop prominently and to overlap more quickly than in thick stock, consists in so confining the work that has already been drawn through the first die between two closely fitting surfaces, so that the metal cannot wrinkle when pulled in and down through the decreased diameters of the successive dies. The wrinkles must never be allowed to fold over one upon the other. The tendency for them to form and fold over is more apt to occur in large work, due principally to the less rigid condition of the walls of the pan and the generally greater difference between the sizes of the successive dies. To obviate the possibility of wrinkles forming, the inside blank-holder is used. It is attached to the ram of a double-action drawing press in the usual way, and operates practically in the same manner as in drawing from the flat blank, holding the work down and against the sides of the die, that should be as high, or nearly so, as the depth of the pan after it has been drawn in the first operation.

Fig. 1 is a sectional view of the cast-iron punch and die for the first operation. The outside diameter of the die *A* should be larger than the diameter of the blank, as it is necessary, when the blank-holder is down on the face of the die, that the work should be held firmly between two flat surfaces to prevent the wrinkles from forming during the operation of drawing. As the punch ascends, the work is kept from rising by the hooked stripping edge *B*. The slight expansion of the tin is usually sufficient to insure its being caught on the shoulder each time. *C C* are holes in the punch for die to enter and escape.

Fig. 2 is a punch and die and inside blank-holder for redrawing. *A* is the cast-iron holder; *B* is a steel die, hardened and ground on the wearing surface and on the outside to fit the holder. The ring is held down by ½-inch screws which are

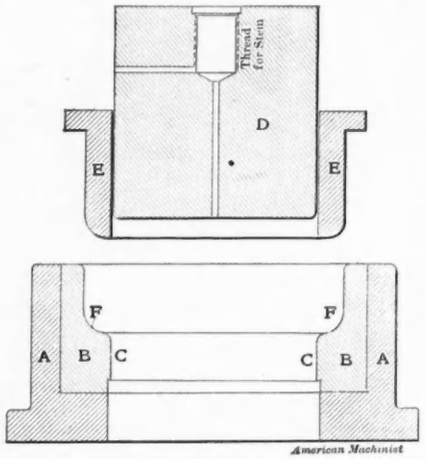


Fig. 2

DRAWING TIN PANS—DIE AND PUNCH FOR FIRST OPERATION.

tapped into the lower edge. *D* is the punch, which requires no description. The inside blank-holder *E* is made from a tool-steel forging. The method of operating consists in first placing the shallow pan from the first drawing into the die; the holder *E* descends and enters the pan, holding it firmly down on the curved surface *F*, which should correspond with that on the bottom of the pan. While the blank-holder is stationary the punch *D* comes down and forces the drawing through the die. It will be observed that if the die is properly made, no distortion or wrinkling can take place in the pan during the operation. A good quality of tin can usually be drawn through three and even four dies before becoming too brittle for further use.

DIE MAKER.

Lynn, Mass.

The Open Door in Machine Shops.

Editor American Machinist:

E. J. Armstrong's letter in your issue of March 1 reminded me of some time ago, when I was looking for a gas engine. I went to the different shops and inspected their igniting, governing and other devices, also asked for the dimensions of the cylinders; for my idea of an economical engine is one with a small cylinder that will give the greatest power possible; that is, I would prefer an engine with a cylinder 5 inches diameter by 5 inches stroke to one having a cylinder 5¼x6½ inches, if their power were both the same, which in this case was 2½ horse-power, guaranteed.

I entered a large shop that employed many men and made many engines, intending to examine their engine, as I had several engines of other makes. What attracted my attention first was a man boring and facing up small flywheels in a lathe, reading the paper and smoking his pipe between cuts!

Soon after I stepped in the shop engine refused to work, and all hands were idle for a while. This gave me a good opportunity to look around. Presently I entered the office of the salesman and asked him a few questions about the engines, but when it came to the dimensions of the cylinder, I was told that the only way to find that out was to buy one and measure it. Mr. Editor, you know that in describing steam engines the dimensions of the cylinder is a point in consideration and always accompanies a description of the same, yet in gas-engine catalogs such a thing is unknown, for I have never seen in one the diameter and stroke stated. Why is it? Do they fear comparisons?

THEORASTUS.

Titles of Australian Patents.

Editor American Machinist:

As a great number of American inventors take out Australian patents, it would do them a service if you were to publish the fact that the titles they use for their applications in Australia are frequently insufficient to properly protect them, and that the titles which are acceptable in the United States are not necessarily so in Australia.

As an example we have just had a case where the title is "Improvements in Rock-Drilling Machines"—not a word about any other machines except drills being stated. But, as a matter of fact, the invention is applicable to many other things, such as power hammers, and the inventor actually knows this and desires that the monopoly shall cover power hammers, and he then frames claims which he thinks will cover power hammers and drills too. In all cases like this the title should be equally broad with the claims, and unless this is done there will be legal trouble ahead in many cases, and the inventor will not be able to secure the wide monopoly he wants, but will be tied down by law to his title.

If you will publish this warning, we shall thereby help inventors to have wider

and safer titles, such as "Improvements in Rock Drills, Power Hammers, and the Like." G. G. TURRI & Co.

Melbourne, Australia.

That Incorrect Reducing Motion Again.

Editor American Machinist:

I thank Mr. S., whoever he may be, for calling my attention, in your issue No. 13, to the fact that the reducing described over my signature in No. 9 would not give a correct motion as it was shown, attached to the engine. It was laid out as Mr. S. suggests, and the error was so slight that for all practical purposes it was correct; but in applying it to the engine the shaft *K* was located as shown to utilize the hole which had been drilled for the reducing wheel mentioned in the article and the pin *C*, to which the cord had been attached, was also utilized. Now, as the sines of the angles which the levers *A K* and *D K* make with a horizontal and vertical line through *K*, respectively, are proportional, it was taken for granted that the motion of the crosshead would be transmitted correctly to the indicator drum, even in the accidental position shown in the sketch; which goes to show that we should prove all things and take nothing for granted. C. E. SARGENT.

A Spherical Grinding Rig.

Editor American Machinist:

I enclose sketches of an attachment for grinding the spherical surface of a punch. It was necessary to grind the face of the punch spherical, with a radius of 1 inch, with the shedder in place, and after the punch had been fitted to the plunger of the sub-press, and as there was no attachment in the shop for doing it I devised the method here shown. I had a bench lathe with a steady rest, and I placed therein the plunger as shown, ready for grinding. In looking over some fixtures that we had for special jobs I found a plate with two holes, one threaded and the other counterbored and with a screw in it. This plate I arranged to have swivel around screw *A*, which held it to the block *B*, which, in turn, was held to the lathe bed by two screws running up through the central slot in the same. I then made block *C* of sufficient hight to bring the grinding attachment up to the center. This attachment, with block *C*, was held at an angle to plate *D* by screw *E*. This completed the fixture, which I then placed in its right position, or nearly so, by using a square placed on *D* and brought against the face of the punch at the center, moving *D* until the center of screw *A* measured 1.01 inches from the face of the punch.

To locate screw *A* central to the plunger I used a straight-edge held against either side of the lathe bed, which had flatted sides, measuring therefrom and shifting plate *B* until the center of screw *A* came to a central position. The two screws holding plate *B* to the lathe bed were considerably smaller than the slot, which allowed for shifting in locating the attachment. The locating of the attachment as I have described it was not without error, but it was easily and accurately located under working conditions by noting the sparks from the wheel as it moved around the spherical surface, and shifting the fixture as required until the sparks were equal at the extreme points at either side of the center. Having assured myself in this way of the fixture's central position, I proceeded to grind to the required diameter by shifting the collar *F* on the grinding spindle for depth of cut until enough had been ground off to have the template *G* fit. While this attachment is not the best that could be devised, it served the purpose, and I did a good job at a cost of little expense and time. W. B. MEHL.

Stamford, Conn.

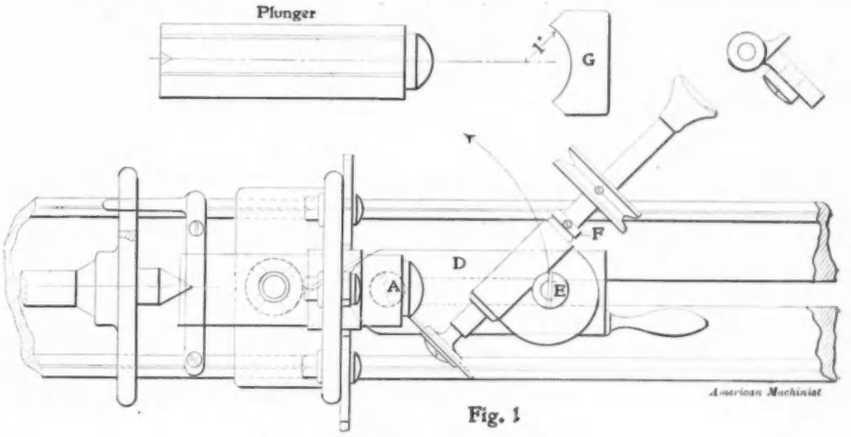


Fig. 1

PLAN OF SPHERICAL GRINDING RIG.

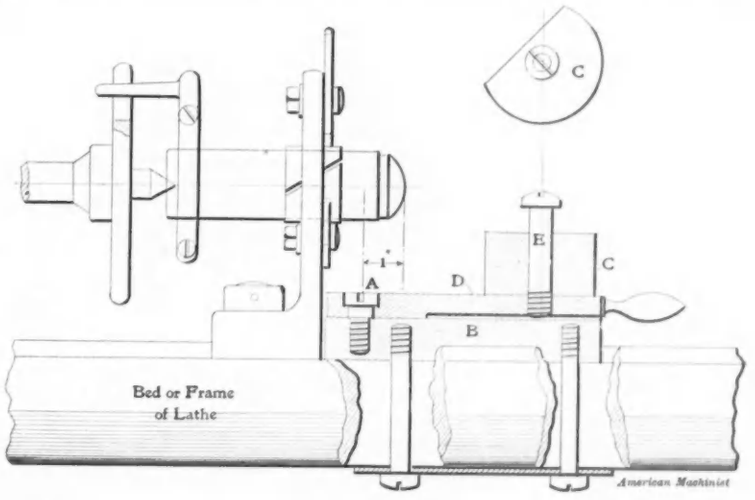


Fig. 2

ELEVATION AND SECTION OF SPHERICAL GRINDING RIG.

Allowing for Rivet Holes in Girders.

Editor American Machinist:

In your issue of March 22 "Constant Reader" asks, and A. D. Williams answers, why rivet holes are considered in tension and not in compression members of plate girders. The answer should have included the statement that allowance for reduction of area by rivet holes in compression members of plate girders (or trusses) can only be omitted in case of good hydraulic riveting. In the case of hand-driven rivets, as in a splice plate added in the field, for instance, it is not safe to count upon the holes being filled by the rivets, and the reduction of area by rivet holes should therefore be considered.

While this may appear a minor correction, yet, on the strength of the statement referred to, one could easily make a girder or a truss 20 per cent. weaker than intended—for a chain (or a girder) is no stronger than its weakest link.

S. L. G. KNOX.

"The Engineer" for March 30 has an article of three columns on "English and American Railways;" another of seven columns on "American Machine Tools," and another of ten columns on "Portable Pneumatic Tools"—all parts of serials.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(7) C. B. B., Toledo, Ohio, says: I am running a 16 horse-power marine engine which at full stroke has about 1-64 lead to the valve. When I hook it back to cut off at about half-stroke the lead disappears and no steam is admitted to the cylinder until the piston has advanced through about one-quarter of the stroke. What is the matter? A.—Your engine has undoubtedly crossed eccentric rods. Open rods give an increasing lead in the early cut-offs, but crossed rods have the opposite effect. The use of crossed rods is very unusual, and if your engine has a notched quadrant, showing it to be intended to be worked at short cut-offs, the probability is that at some time when undergoing repairs the parts have been put together wrong. In that case any competent marine engine shop should be able to set matters right. On the other hand, if the engine was intended to be worked in the full gear only, the designer may have intended it to be as it is.

(8) F. R. Z., Wilmington, Del., asks: What is the origin and what the reason for the terms "two cycle" and "four cycle" as applied to gas engines? A.—These terms, like many others relating to mechanical details, are not the happiest that might have been devised, and, like most of them also, no one has kept records of their origin. Someone first used them and others have continued to make them serve a purpose. In the four-cycle engine there are four distinct operations, occurring upon four successive strokes of the piston. These are: First, the filling of the cylinder with a mixture of gas and air; second, the compression of the charge into the combustion chamber; third, the explosion of the charge and the driving the piston forward by its expansion; fourth, the expulsion of the used up charge. In the two-cycle engine these operations, as nearly as they can be duplicated, are made to occur in two strokes of the engine instead of four. The gas and air mixture is drawn in during a part of the stroke, exploded and expanded in the same stroke and discharged upon the return stroke.

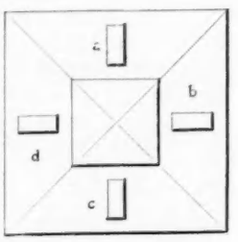
(9) A. B. C., Meriden, Conn., writes: Fig. 1 is a plan and elevation of a piece of work composed of four pieces *a, b, c, d,* mitered together as shown Each piece has a rib cast on it in order to hold it in a planer chuck, as shown in Fig. 2, and circumstances are such that the work must be held in this way. How can I figure out the angle for setting the planer head, so that the sections will miter correctly? Of course, if I could set the pieces so that the center line would be parallel to the planer platen, the head would need to be set at 45 degrees; but in the present case this is impossible. A.—We have added Fig. 3 to show more clearly the solution of the problem. The inner lines of the right-hand view give the elevation of the end, and the outer lines show the true shape of that end when revolved to a perpendicular position. What is wanted is the value of the angle α. Calling the angle at the base of the piece β, we have:

$$\frac{a}{b^1} = \text{tan. } \alpha$$

$$\text{and } \frac{b}{b^1} = \text{cosec. } \beta$$

$$\text{or } b^1 = \frac{b}{\text{cosec. } \beta}$$

Substituting this value of b^1 in the first equation gives:



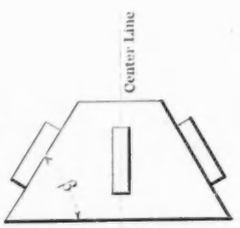


Fig. 1

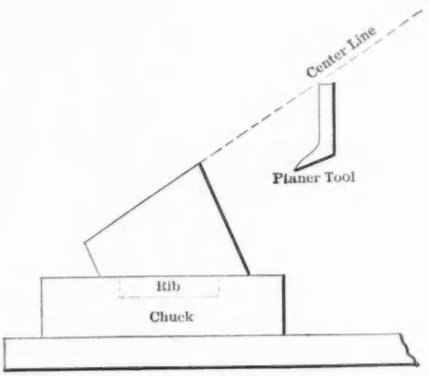


Fig. 2

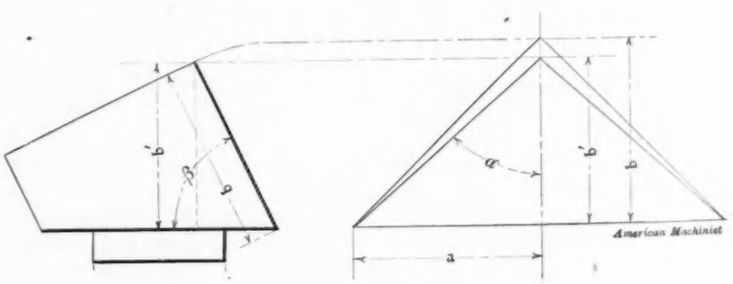


Fig. 3

$$\frac{\frac{a}{b}}{\text{cosec. } \beta} = \text{tan. } \alpha$$

$$\text{or } \frac{a \text{ cosec. } \beta}{b} = \text{tan. } \alpha$$

Since the real angle of the inclination of the side of the piece, as seen in the revolved position, is 45 degrees, it follows that $a = b$, or

$$\text{cosec. } \beta = \text{tan. } \alpha$$

That is, measure the angle β at the base of the piece, consult a table of natural trigonometrical functions and find the cosecant of the angle. Then find this same value in the column of tangents, and opposite it will be found the value of the angle required. This rule is of course applicable to cases like the present only, in which the true angle of the piece is 45 degrees.

Rival Exhibition in Russia—Locomotives Wanted in Russia—New German Tariff Schedule.

According to reports from Consul-General Frank H. Mason and Vice-Consul Monaghan, in Germany, the published announcement that the American exhibitors of agricultural machinery at the Paris Exposition would, after the close, transfer their exhibits to a special exhibition of machinery to be held at Moscow during the autumn of the present year has suggested a counter move on the part of the "Central Union of German Industrials." This association has issued to all German manufacturers of agricultural implements and machinery a circular, in which it is proposed that they shall forestall the American exhibition at Moscow by transferring to some well-chosen city in Russia the machinery and implements of German manufacture which are to be exhibited at the forthcoming exposition in Posen, from the 7th to the 12th of June next. It is un-

derstood that twenty-four firms, including all the most important German manufacturers of agricultural implements and machinery had, at the time of the report, already returned favorable answers, so that it may be safely assumed that the proposed exhibition will be opened at some carefully chosen point in Russia about the 1st of July, four or five months in advance of the opening of the American exposition at Moscow.

Consul Halstead writes from Birmingham, February 19, 1900, that the London correspondent of the Birmingham "Daily Post" announces: "According to advices which have reached an official quarter here from St. Petersburg, tenders for the supply of 200 locomotives and some thousands of goods trucks will be invited by the Russian Government in the early spring. The locomotives are to be of unusually heavy make and great power, capable of drawing a load half as heavy again as that allowed for the engines already being employed on the completed sections of the Siberian Railroad."

Vice-Consul-General Simon W. Hanauer reports from Frankfort, Germany, under date January 20, that the new German tariff schedule prepared by a committee of economic experts is characterized by a minute specialization of articles, with numerous annotations and explanations, giving a closer and more exact grading. He believes that this will affect many articles of American manufacture, such as bicycles, machines and fine iron ware. It would therefore be advisable for manufacturers of machine tools and other machinery who export largely to the German Empire to secure and closely examine a copy of this new schedule.

Machinery Exports for February.

The "Monthly Summary of Commerce and Finance," compiled by the Bureau of Statistics, United States Treasury Department, for February, 1900, shows metal working machinery shipments for that month of $585,854; for February, 1899, $435,094. For January, 1900, they have previously been reported at $586,837. For the eight months ending February, 1900, they were $4,685,984, and for the eight months ending February, 1899, $4,193,905.

Electrical machinery exports were: For February, 1900, $291,678; February, 1899, $134,412; January, 1900, $342,973; eight months ending February, 1900, $2,432,912; eight months ending February, 1899, $1,826,647.

Pumps and pumping machinery: February, 1900, $241,393; February, 1899, $199,477; January, 1900, $266,723; eight months ending February, 1900, $2,047,218; eight months ending February, 1889, $1,641,001.

Stationary engines: February, 1900, 108, at $33,953 aggregate value; February, 1899, 33, at $23,684; January, 1900, 118, at $85,779; eight months ending February, 1900, 739, at $420,013; eight months ending February, 1899, 319, at $195,209.

Printing presses and parts thereof: February, 1900, $113,176; February, 1899, $33,264; January, 1900, $113,006; eight months ending February, 1900, $805,014; eight months ending February, 1899, $461,992.

Locomotive engines: February, 1900, 39, at $386,765 aggregate value; February, 1899, 27, at $229,503; January, 1900, 49, at $437,702; eight months ending February, 1900, 332, at $3,490,025; eight months ending February, 1899, 342, at $3,178,642.

Boilers and parts of engines: February, 1900, $80,615; February, 1899, $77,104; January, 1900, $123,242; eight months ending February, 1900, $1,136,957; eight months ending February, 1899, $783,989.

Typewriting machines and parts thereof: February, 1900, $213,156; February, 1899, $201,312; January, 1900, $210,990; eight months ending February, 1900, $1,726,142; eight months ending February, 1899, $1,374,468.

Sewing machines and parts thereof: February, 1900, $345,272; February, 1899, $262,505; January, 1900, $329,575; eight months ending February, 1900, $2,902,139;

(*Continued on page 46.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 20.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

U. S. and Canada patent for sale, cheap. Address Box 240, AMERICAN MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies & Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

Wanted—Second-hand lathe, 16 in. by 8 ft., reversible chuck, taper attachment and cross feed. L. J. Lilly, Duke Center, Pa.

For Sale—Two geared Ferracute presses, 62 in. between uprights; little used, and in good condition. Address W. H. Mullins, Salem, Ohio.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. by G. W. Dixon, Spring Lake, Mich.

Wanted—One second-hand bevel gear cutter having capacity up to 12 in.; must be of standard make and perfect condition. Box 282, AMERICAN MACHINIST.

Would be pleased to correspond with parties having some specialty in the line of light machinery to build or model work. Address Box 475, Hornellsville, N. Y.

For Sale—New Era Gas Engine, 35 horsepower, latest type; bought for emergency and used only six weeks; a bargain for someone. Address Cleveland Punch & Shear Works Co., Cleveland, O.

For Sale—Half interest in an established machine shop in New York, doing a profitable business; price $7,500; good reasons for selling; principals only dealt with. A. B. C., Box 297, AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Worner Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Draftsman, general machinery, for South or Mexico. Box 284, AMERICAN MACHINIST.

Tool dresser wishes position; can harden taps, etc. Box 300, AMERICAN MACHINIST.

Draftsman, mechanical, wants position, experienced hydraulic, engine. Box 308, AM. M.

Practical master mechanic wants position with large concern; now employed. Box 298, AMERICAN MACHINIST.

Position wanted in the vicinity of New York City, as superintendent, mechanical engineer or designer. Box 309, AMER. MACHINIST.

Position by young man, 27, with technical experience, assisting manager or engineer of large works; A1 references. Box 307, AMERICAN MACHINIST.

Foreman desires to make a change; an up-to-date, first-class, all-round mechanic; will take charge of tool room or manufacturing department. Address "Conn.," care AMERICAN MACHINIST.

A machine-shop foreman desires a change; experienced in engines, plantation machinery and general machine-shop work; can handle men successfully; best references. Box 293, AMERICAN MACHINIST.

Mechanical engineer, with considerable experience in building special machinery and tools for manufacturing, wants position as superintendent of a shop; Middle West preferred. Box 299, AMERICAN MACHINIST.

Machinist and draftsman, age 33, with technical education, speaking English, German, French and Russian, wants position here or abroad, preferably with exhibitor at Paris Exhibition. Box 301, AMER. MACH.

Bronze and Brass Founders, Attention!—A strictly temperate, capable foreman or foundry superintendent, expert metal mixer, thoroughly practical man, is open for engagement. "Bronze," AMER. MACHINIST.

Situation wanted as foreman boiler maker, stationary, marine, tank and sheet-iron work; large experience on repair work; 15 years at Corliss boilers; journeyman 25 years; experienced layer-out. Henry Mellon, South Boston, Mass.

First-class patternmaker wants a position as foreman; has had experience on all kinds of machinery patterns; has been for the past 4 years and is now assistant over 20 men; reference as to ability and character. A. B., AMERICAN MACHINIST.

By young man, thorough mechanic with modern methods, handles men efficiently in shop or outside, place as master mechanic or superintendent; preference heavy work; capable of erecting and equipping; practical engineer. Address "Work," care AMER. MACH.

A superintendent wants engagement; best of experience in general machinery and engines, also in design and construction of the most improved refrigerating and ice-making machines, etc., including the carbonic machines; would buy some interest. Box 302, AMERICAN MACHINIST.

Mechanical draftsman with practical experience, French nationality, speaking French and English, 6 years' practice in America, good education, wants position with manufacturer at Paris Exposition, or to accompany visitor in a professional capacity; good references. Address Box 294, AM. MACH.

Position as foreman, either tool room, machine shop or manufacturing, by an energetic and thoroughly capable mechanic; up to date on engines, special and automatic machinery and all branches of tool-room work, jigs, gages, fixtures, dies, etc., and the economic production of manufactured and interchangeable parts, wire and sheet-metal specialties. Parties desiring a young man of energy and good executive ability address for references and fuller information, "American," care AMERICAN MACHINIST.

A mechanical engineer of known reputation, 38 years of age, with 23 years' practical experience in the leading factories of New England, at present and for the last 8 years holding the position of superintendent, desires to make a change and associate himself with reputable and up-to-date business men, where executive ability, good organizing qualities and practical results attained would

(*Continued on page 46.*)

(*Continued from page 45.*)

eight months ending February, 1899, $1,881,553.

Cash registers: February, 1900, $60,346; January, 1900, $66,676; eight months ending February, 1900, $545,048.

Personal.

Gustavus Odholm has resigned his position with the American Hard Rubber Company, as superintendent of the machine department of its works at College Point, N. Y. William S. Cobb, of Philadelphia, Pa., is his successor.

W. B. Wood, formerly connected with the Cornell Machine Company, Chicago, Ill., has been appointed manager and sales agent of the Chicago office, Monadnock Building, of the Weber Gas & Gasoline Engine Company, of Kansas City, Mo.

Obituary.

John Rick, of the firm of Rick Brothers, hardware manufacturers, Reading, Pa., died April 5, sixty-one years old.

J. R. Stewart, president of the Bradford Machine Tool Company and vice-president of the E. A. Kinsey Company, both of Cincinnati, died at Riverside, Cal., March 31.

Horace Crosby, second vice-president of the National Tube Works Company, died at Pittsburgh April 5, fifty-two years old. He was made assistant general manager in 1895, and in 1899 he was made second vice-president, with full control of the manufacturing department.

Alonzo Whitcomb, founder of the Whitcomb Manufacturing Company, Worcester, Mass., manufacturers of iron planers, died March 28, eighty-two years old. Mr. Whitcomb had been building planers sixty years. He was also partner in the Kabley Foundrey Company, of Worcester.

Isaac W. Van Houten, for nearly half a century connected with the Pennsylvania Railroad Company, died in Philadelphia April 1, eighty-seven years old. He entered the employ of the Camden & Amboy Company in 1846; four years later was in the Harrisburg shops and a year after that he was placed in charge of the car shops at West Philadelphia, and in 1870 he was made general foreman of the plant, which position he retained until two years ago.

George Richards died in New Orleans, April 3, sixty-seven years old. He was born in Pottsville, Pa., and at eighteen years of age was employed at an iron mine in New Jersey. In recent years Mr. Richards was president of the Dover (N. J.) Iron Company and of the Morris County Machine & Iron Company, and simultaneously was an officer of nearly twenty other companies. He had also held various appointment offices in the service of the State.

Situations Wanted—Cont'd.

be appreciated; would take full charge and responsibility of the manufacturing department, capable also of installing a factory complete in every detail; experienced in designing and building special machines, cutting tools and fixtures for work on the interchangeable plan; experienced also in the cold working of steel; salary not so much of an object as an interest in the business, which I would make valuable. Parties desiring a man possessed of originality, resource, energy and ability, can address Box 296, AM. MACH.

Help Wanted.

Wanted—Good mechanical draftsman for pump work; must be No. 1. Box 287, AM. M.

Experienced template makers wanted; bridge and structural work. Dominion Bridge Company, Montreal, Canada.

Wanted—Foreman for steel foundry, also 10 steel molders. American Hoist & Derrick Co., St. Paul, Minn.

Wanted—A capable draftsman, experienced in high-speed engine construction. Address "X.," care AMERICAN MACHINIST.

Wanted—Foreman for tool-making department; must be a man of experience and ability. Address "A.," care AMER. MACHINIST.

Wanted—Planer hands, vise hands, lathe hands, milling machine hands; steady work; good pay. Address "Chicago," care AM. M.

Wanted—Foreman for large and modern machine shop, building medium and heavy machinery; Lake region. Box 305, AMERICAN MACHINIST.

Wanted—First-class draftsman on steam engines; steady employment; give experience, references and wages expected. Box 303, AMERICAN MACHINIST.

Experienced draftsmen wanted on mill machinery and machine tools; permanent employment assured to rapid and accurate draftsmen. Box 260, AMERICAN MACHINIST.

Wanted—2 or 3 first-class machinists accustomed to building light, fine machinery and tools. D'Amour & Littledale Machine Co., Centre and Worth sts., New York.

Machinists wanted; several first-class machinists for erecting and running lathes; none but good, sober mechanics need apply; no trouble. Address P. O. Box 549, Wheeling, W. Va.

Wanted—First-class salesman for electric traveling cranes; must be thoroughly competent and experienced; good opening for a man of ability and energy. Box 290, AMERICAN MACHINIST.

Wanted—Draftsman; a young man with some practical experience on machine tools, careful and dependable; steady employment for satisfactory man. Hilles & Jones Company, Wilmington, Del.

Wanted—Machine shop foreman, also a superintendent to work about 140 men; also several good machinists and machine hands. De Loach Mill Mfg. Co., Atlanta, Ga., and 110 Liberty st., New York City.

Wanted—An experienced draftsman on oil mill machinery; preferably one with some experience in shop work. Address, with references and salary expected, "Manufacturer," Box 304, AMERICAN MACHINIST.

Wanted—Factory superintendent of good inventive ability and expertness in designing tools and jigs for interchangeable parts, such as of sewing machines, clocks, cash registers or typewriters. Box 311, AMER. MACHINIST.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Four first-class draftsmen on high-grade gas-engine, steam-engine and boiler work; state age, experience and salary desired; must be able to furnish references; none but sober, steady men need apply. Address "Industrial," care AMER. MACHINIST.

Wanted—A number of first-class iron molders; men who want to enter the employment of a company who believe in fair play and free labor; none but strictly temperate men need apply; steady work and good wages. Brown & Sharpe Mfg. Co., Providence, R. I.

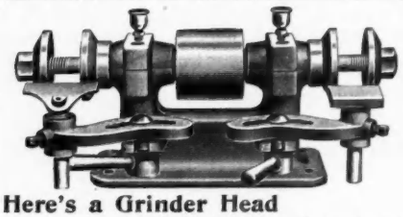
Wanted—Mechanical engineer with demonstrated executive ability, who is familiar with electrical apparatus, as superintendent and manager of manufacturing plant building a high grade of machinery; give age, experience and references. Box 289, AMER. MACH.

Wanted—Designing draftsman for large modern machine shop, which belongs to a corporation operating large mills, water-power plants, mines, S. S. and R. R. lines, etc.; must be capable of designing machinery for any of these plants; Lake region. Box 306, AM. M.

Wanted—A man with mechanical ability as well as general business qualifications, who has had thorough experience in low-cost production of high-grade articles, as manager for large machinery manufacturing concern; a good and permanent position to the right party. Box 310, AMERICAN MACHINIST.

Working foreman in small malleable iron foundry; must have knowledge of cupola practice and know how to melt and mix charcoal iron to produce best results; also working foreman for malleable iron annealing room; state experience and where. The Walter W. Woodruff & Sons Co., Mount Carmel, Conn.

Wanted—First-class layer-out for boiler shop, capable of laying out plates for all kinds of boilers, tanks and general jobbing products; must be sober, reliable and capable of working from blueprints, without other instruction. Address, stating age, salary wanted and present employer, "Layer-out," care AMERICAN MACHINIST.



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is practically perfect. No other is so economical, because practically no steam is wasted, and all the heat not employed in the thermodynamic operation of forcing water into the boiler, is saved by being returned to the boiler from which it came.

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